

VOLUME XXXIV

NUMBER 3

JOURNAL
OF THE
ARNOLD ARBORETUM
HARVARD UNIVERSITY

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JULY, 1953



PUBLISHED BY

THE ARNOLD ARBORETUM OF HARVARD UNIVERSITY

JAMAICA PLAIN, MASS.

1953

THE JOURNAL OF THE ARNOLD ARBORETUM

Published quarterly by the Arnold Arboretum of Harvard University.

Subscription price \$7.00 per year. Price of single numbers \$2.00.

Vols. I-XI out of print. Vols. XII-XIII: Price \$3.00 each; single numbers \$1.00 each. Vols. XIV-XXVIII: Price \$4.00 each; single numbers \$1.25 each. Vols. XXIX-XXXIII: Price \$7.00 each; single numbers \$2.00 each.

Subscriptions and remittances should be addressed to the ARNOLD ARBORETUM, JAMAICA PLAIN, MASSACHUSETTS.

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Vol. XXXIV, No. 2, including pages 97-190, was issued April 15, 1953.

Entered as second class matter April 4, 1940, at the post office at Boston, Massachusetts, under the Act of August 24, 1912.

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PLANTAE PAPUANAE ARCHBOLDIANAE, XXI * THE PAPUASIAN SPECIES OF *MACARANGA*

LILY M. PERRY

IN 1876 THE GENUS *Macaranga* Thouars was first reported from New Guinea by F. Mueller. He published a single species, *M. aleuritoides*, in his Descriptive Notes on Papuan Plants. As exploration continued on the island other species were collected. Seven species and two varieties were recorded by Warburg as additions to the Papuan flora in *Botanische Jahrbücher*, 13: 349-352. 1891. The first comprehensive flora of the north-east region of New Guinea was published by K. Schumann & Lauterbach, *Fl. Deutsch. Schutzgeb. Südsee*, 1900. This contained fourteen species of *Macaranga*. In 1910 and 1912 J. J. Smith, *Nova Guinea (Botanique)*, added several species from Netherlands New Guinea. The first comprehensive work on the genus after that of Müller Argoviensis in *DC. Prodrômus* 15(2): 987-1016, is that of Pax & K. Hoffmann in *Das Pflanzenreich*, 63 (IV. 147. VII). Here, there are twenty-four species recorded from New Guinea. Five years later, 1919, in *Pflanzenreich*, 68 (IV. 147. XIV), Pax & K. Hoffmann added twenty more to the previously known species from that region. These were based chiefly on the large collections of Ledermann from the Sepik (Kaiserin Augustafluss-Expedition) River region. Since then only occasional new species have been reported. Meanwhile the collections of the Archbold Expeditions have been accumulating. These, with a considerable loan from the Bogor Herbarium, the Carr material from the British Museum, and the Papuan *Macaranga* from the Brisbane Herbarium, and that of Lae, form the basis of the work here presented. It brings together in one place the species of the Papuasian region. The study is admittedly incomplete. In determining specimens of a variable and dioecious genus, such as *Macaranga*, it is important to have material from both the staminate and the pistillate plants. Unfortunately, all too often this fact has not been recognized, and, as a result, species have been described from collections representing a single sex. It is difficult indeed to match a pistillate unknown with the description of a stami-

* Botanical Results of the Richard Archbold Expeditions. See *Jour. Arnold Arb.* 32: 369-389. 1951.

nate specimen, and even more so vice versa. This same difficulty presents itself when a key is to be drawn for the species. Another difficulty is the lack of sufficient material to estimate the variability within a species with any degree of accuracy. A question one often ponders is — what constitute good specific characters in this genus? Some of the findings which I consider pertinent are recorded below:

Stipules: The stipules seem to be fairly constant in size, outline and pubescence. Since usually they are shed rather quickly, good specimens should have at least two terminal buds. In several species the stipules are connate forming a single scale covering the terminal bud in the axil of the uppermost leaf. Such stipules leave a ring-like scar. In all species reported in this article as having connate stipules, a stipule has been removed from a bud for verification. There are other species which apparently bear large leaves clustered at or near the apex of the branchlets; here the stipules are large and it is not easy to determine whether they are connate or separate. However, if one is so fortunate as to have a part of the branchlet showing stipular scars, it may be noted that when the stipules are in pairs broad enough to surround the young branchlet, one is slightly higher than the other at the point of meeting, so the scar is slightly uneven at that point.

Leaves: In the group of species with palmately veined leaves, the character of lobed versus entire leaves is often unsatisfactory and one to be used much more cautiously than it has been in the past. Great variation is also encountered in the size and width of leaves even on the same branchlet.

Staminate inflorescence: Only a few staminate inflorescences are simple; most are panicles. The bracts subtending the branchlets should possibly be regarded as a negligible character, as these in most instances appear to have fallen from the herbarium specimens. However, the bracts subtending the glomerules are persistent and, although showing variation, are reasonably reliable. The presence or absence of patelliform glands appears to be quite constant, although the glands may vary in size, shape and position. Within limits the number of stamens tends to be a good character, but several dissections are necessary to establish the number accurately and it is preferable to have more than one gathering to work upon. Most anthers are four-locular, but in a few species both three-locular anthers and four-locular anthers occur in the same flower. Again in some species three-locular anthers are constant, while in one *Macaranga* two-locular anthers are found. In at least seven species the calyx is lobed only to the middle, although in most species the sepals are free or the calyx is tripartite.

Pistillate inflorescence: The bracts appear to fall very quickly from the pistillate inflorescence; however, if several of them can be seen, they offer a certain parallel with those found in the staminate inflorescence. The calyx is distinctive, at least for closely related groups, but this too is displaced by the growing flower and seldom observed. The unilocular character of the ovary appears to be dominant in certain species, but in *M. ovatifolia* Merr. from the Philippines, and here reported from the Solomon Islands, the bilocular ovary is almost as frequent as the unilocular ovary on

the same specimen. Occasionally specimens have both smooth capsules and capsules irregularly marked with small tubercles. The majority of the species have capsules with processes. Any outgrowth which appears longer than broad is here regarded as a process. In *M. induta* the processes are broad in proportion to their length and obtuse. Some species have rather fine and relatively long, almost filiform, processes. On the other hand, *M. caudata* Pax & K. Hoffmann is marked by very short processes, almost short enough to be termed tubercles. However, they have minute hairs at the apex similar to those found along the long processes in other species. In *M. clemensiae* and *M. fragrans* the base of the process is broad. Another feature of the processes to be noted here is that in some species they tend to slough off as the capsule matures, so that the capsule, unless carefully observed, sometimes appears smooth.

Pubescence: The type of pubescence rather than the quantity is here regarded as a criterion. The terminal bud, the lower surface of the leaves, and the inflorescence usually have the same type. Often pubescence rubs off, but that found on the terminal bud and the inflorescence is fairly constant.

In the key given below I have not attempted to follow the phylogenetic order of Pax & K. Hoffmann, but rather to use those superficial characters which might aid in the identification of future collections.

I am deeply grateful to the directors and curators of the various herbaria who have given me the privilege of studying their material. I am indebted to Dr. E. D. Merrill for the photographs of two types and carbon rubbings of leaves of several other species not represented here. I also express my appreciation for the kindness of Dr. Taylor in having Mr. Stearn check a type-specimen in the British Museum for me. The institutions from which material for this study was used are indicated as follows: A — Arnold Arboretum; BM — British Museum; BO — Bogor Herbarium; BR — Brisbane Botanic Museum and Herbarium; F — Herbarium Universitatis Florentinae; G — Gray Herbarium; LAE — Department of Forests, Lae, New Guinea; MICH — University of Michigan; NY — New York Botanical Garden.

KEY TO THE SPECIES

- A. Stipules connate (the terminal bud with a single scale).
 - B. Bracts subtending the ♂ glomerules not patelliform-glandular on the upper surface. 1. *M. belensis*.
 - BB. Bracts subtending the ♂ glomerules patelliform-glandular on the upper surface.
 - C. Leaves conspicuously bullate. 2. *M. eymae*.
 - CC. Leaves not bullate, or if bullate only observed with the aid of a lens.
 - D. Capsule smooth; leaves lanceolate or ovate-lanceolate. 3. *M. reiteriana*.
 - DD. Capsule processed (not known in *M. pleytei*); leaves ovate, elliptic or lobed.
 - E. Anthers 2-locular. 4. *M. cucullata*.
 - EE. Anthers mostly 3-locular, 4-locular ones occasionally occurring.

- F. Leaves peltate; pubescence on the branchlets ca. 4 mm. long. 5. *M. pleytei*
- FF. Leaves not peltate; pubescence on the branchlets not more than 2 mm. long.
 - G. Leaves biauriculate at the apex of the petiole.
 - H. Bracts subtending the ♂ glomerules linear, dilated at the apex and bearing a single orbicular patelliform gland; bracts subtending the ♀ flowers lanceolate or linear, narrowed at the base; calyx of the ♀ flower 6–8 mm. long; styles 0.8–2 cm. long. 6. *M. aleuritoides*.
 - HH. Bracts subtending the ♂ glomerules 3-lobed, the two basal lobes rounded, the middle lobe suborbicular and patelliform-glandular; bracts subtending the ♀ flowers ovate; calyx of the ♀ flower hardly 4 mm. long; styles ca. 0.5 cm. long. 7. *M. papuana*.
- GG. Leaves not auriculate at the apex of the petiole.
 - H. Leaves elliptic-ovate, somewhat narrowed towards the apex and base, 3-nerved at the base; stipules 1.5–3 cm. long; sepals of the ♂ flower about 0.5 mm. long; stamens with 3-locular anthers; calyx of the ♀ flower about 3.5 mm. long. 8. *M. tessellata*.
 - HH. Leaves ovate or subrhombic-ovate or lobed, palmately 5-nerved; stipules 5–11 cm. long; sepals of the ♂ flower 1 mm. long; stamens with 3-locular (some with 4-locular) anthers; calyx of the ♀ flower 1 cm. or more long. 9. *M. platyclada*.
- AA. Stipules separate (the terminal bud with two scales).
 - B. Bracts patelliform-glandular on the upper surface (♀ inflorescence unknown in *M. astrolabica*, *M. bullata*, and *M. stenophylla*, ♂ inflorescence unknown in *M. advena*).
 - C. Capsules with processes.
 - D. Leaves broadly (0.5–6.5 cm.) peltate.
 - E. Leaves bullate. 17. *M. bullata*.
 - EE. Leaves not bullate.
 - F. Stamens with 3-locular anthers; stipules 2–3 cm. long; leaves 1.5–6.5 cm. peltate. 10. *M. fallacina*.
 - FF. Stamens with 4-locular anthers; stipules less than 2 cm. long.
 - G. Stamens 15 or 16. 12. *M. stenophylla*.
 - GG. Stamens not more than 12.
 - H. Leaves 1.3–2.5 cm. peltate; capsule 2-locular with long (5–7 mm.) processes. 11. *M. salomonensis*.
 - HH. Leaves 0.4–0.8 cm. peltate; capsule 1-locular with shorter (up to 2.5 mm.) processes.
 - I. Stipules lanceolate or lance-ovate, 1–1.7 cm. long; inflorescence velutinous; bracts

- subtending ♀ flowers subfoliaceous; style 6–9 mm. long. 27. *M. similis*.
- II. Stipules linear-lanceolate or linear-oblong, 0.4–0.7 cm. long; inflorescence ferrugineous-tomentulose; bracts subtending ♀ flowers not foliaceous; style 4 mm. long. 29. *M. punctata*.
- DD. Leaves apeltate or only slightly (0.2–0.4 cm.) peltate.
- E. Leaves 3–5-nerved or at least 3-nerved at the base.
- F. Ovary 2-locular (in *M. strigosa*, var. *carrii* sometimes 3-locular).
- G. Stipules 3–5.5 cm. long; capsules with very short (0.2–0.4 mm.) processes. 15. *M. caudata*.
- GG. Stipules not more than 2 cm. long; capsules with processes 1.5–4.5 mm. long (not known in *M. warburgiana*).
- H. Calyx of ♀ flowers urceolate or subtubular and denticulate, not splitting into almost even lobes; leaves not bullate except in *M. strigosa*.
- I. Stamens 11–18. 13. *M. rufibarbis*.
- II. Stamens 2–8.
- J. Stamens 2–4 with 3- or 4-locular anthers, mostly 3-locular.
- K. Leaves cordate at the base; petioles fulvous-setose with retrorse hairs; ♂ panicle villous. 16. *M. strigosa*.
- KK. Leaves truncate at the base; petioles glabrous; ♂ panicle glabrous. 18. *M. warburgiana*.
- JJ. Stamens 4–8 with 4-locular anthers.
- K. Leaves deeply bifoveate at the base; ♂ bracts thickish and cucullate or apiculate. 19. *M. bifoveata*.
- KK. Leaves with 4 flat glands at the base; ♂ bracts ovate, acutish or obtusish, not usually thickened. 20. *M. latifolia*.
- HH. Calyx of ♀ flowers conic, apparently splitting into 2 or 3 regular lobes; leaves more or less bullate. 21. *M. glandulifera*.
- FF. Ovary 1-locular (processes often caducous as fruit matures).
- G. Bracts of the ♀ inflorescence foliaceous; pubescence velutinous or spreading-pilose, not crisply tomentose nor setulose.
- H. Bracts subtending the ♂ glomerules dentate; stamens 3 or 4. 22. *M. densiflora*.
23. *M. dalechampioides*.

- HH. Bracts subtending the ♂ glomerules entire; stamens 4–12.
- I. Pistillate bracts lanceolate or linear-lanceolate, entire. 24. *M. urophylla*.
- II. Pistillate bracts ovate or triangular-ovate denticulate or dentate.
- J. Stipules narrowly linear, 4–10 mm. long; leaves rounded, or truncate and retuse, or very slightly cordate at the base.
- K. Style 7–10 mm. long; capsule with processes 1.5–2.5 mm. long. 25. *M. involucrata*.
- KK. Style 4–6 mm. long; capsule with processes hardly 1 mm. long. 26. *M. schleinitziana*.
- JJ. Stipules lanceolate or lance-ovate or slightly obovate-oblong; leaves cordate at the base. 27. *M. similis*.
- GG. Bracts of the ♀ inflorescence not foliaceous; pubescence crisply tomentose or setulose.
- H. Capsule with very short (0.4–0.6 mm.) processes; pubescence setulose; stamens 2 or 3. 28. *M. chrysotricha*.
- HH. Capsule with processes about 2 mm. long; pubescence crisply tomentose; stamens 3–10 29. *M. punctata*.
- EE. Leaves pinnately nerved.
- F. Capsule 2-locular; stamens 2–4; ♀ bracts linear-lanceolate, narrowed towards the base. 14. *M. decipiens*.
- FF. Capsule 1-locular; stamens 11–15 (not known in *M. advena*).
- G. Leaves ovate-lanceolate with narrowly linear apex up to 4 cm. long; stipules ovate; ♀ bracts rhombic-ovate and narrowed at the base, patelliform-glandular within the margin. 30. *M. advena*.
- GG. Leaves lanceolate, acuminate; stipules linear-subulate; ♀ bracts, at least the lower ones (sometimes the upper small and lacking glands), ovate with entire or dentate apex, reflexed, and bearing near the base 2 large oval patelliform glands. 31. *M. angustifolia*.
- CC. Capsules smooth or marked irregularly with obtuse tubercles (not known in *M. astrolabica*).
- D. New growth and inflorescence glabrous or inflorescence slightly puberulous; leaves lanceolate, subcoriaceous; capsule smooth, glabrous.
- E. Stamens 2. 32. *M. astrolabica*.
- EE. Stamens 10–16. 54. *M. gracilis*.

DD. New growth and inflorescence brownish sublanate-tomentose; leaves ovate, rather stiff; capsule tomentulose, smooth or sometimes with a few tubercles. 33. *M. sterrophylla*.

BB. Bracts not patelliform-glandular on the upper surface (♀ unknown in *M. haplostachya*, *M. hofmannii*, *M. kostermansii*, *M. longicaudata*, and *M. womersleyi*; ♂ unknown in *M. inermis*, *M. clemensiae*, and *M. magnifolia*); anthers usually 4-locular.

C. Leaves obviously bullate; capsules with processes.

D. Leaves coarsely bullate, the elevations on the upper surface about 5 mm. long, 2–3 mm. broad. 34. *M. clemensiae*.

DD. Leaves more finely bullate, the elevations on the upper surface not more than 3 mm. long, 1–2 mm. broad.

E. Leaves caudate-acuminate, the acumen almost linear and 2–3 cm. long; venation close.

F. Staminate inflorescence (including the flowers) densely brown-tomentose; lower surface of the leaves densely tomentose, the veins villous. 35. *M. womersleyi*.

FF. Staminate inflorescence hirtellous; flowers glabrous; lower surface of the leaves not tomentose, all the veins hirtellous. 36. *M. longicaudata*.

EE. Leaves gradually or subabruptly acuminate, but not caudate; venation not so close.

F. Leaves 0.5–1 cm. peltate; ovary 1-locular 37. *M. leonardii*.

FF. Leaves rounded or slightly cordate at the base, scarcely peltate; ovary 2-locular. 38. *M. carrii*.

CC. Leaves not or only very slightly bullate; capsules smooth or with processes.

D. Leaves peltate.

E. Leaves broadly (1.5–20 cm.) peltate; stipules medium to large (1–13 cm. long).

F. Stamens with 3-locular anthers; capsules bilocular, with processes 1.5–3 mm. long. 10. *M. fallacina*.

FF. Stamens with 4-locular anthers; capsules 2–5-locular.

G. Stipules large, 4–13 cm. long; leaves large, 34–76 cm. long; capsules with short (0.5–2 mm.) tomentulose processes, or tuberculate, 2- or 3-locular; subtending bracts (where known) tomentulose on both sides.

H. Capsules densely covered with short (0.5–2 mm.), tomentulose processes. 39. *M. fragrans*.

HH. Capsules densely granulo-glandular and somewhat irregularly tuberculate; tubercles 0.5–0.7 mm. high, 1–1.5 mm. broad, pubescent. 40. *M. magnifolia*.

GG. Stipules smaller, 1–3 cm. long; leaves 7–33 cm. long; capsules with long (3–15 mm.) slender processes, 2–5-locular; subtending bracts glabrous or somewhat velutinous.

H. Bracts subtending the ♂ glomerules ovate, deeply concave and entire or sinuate; stamens

- 2 or 3; ovary (3-) 4-5-locular; leaves usually bearing 1-4 maculate glands on the basal nerves between the insertion of the petiole and the lower margin. 41. *M. quadriglandulosa*.
- HH. Bracts subtending the ♂ glomerules suborbicular-ovate, pectinate-lacinulate or dentate; stamens 4-14; ovary 2-3-locular; leaves usually without maculate glands. 42. *M. tanarius*.
- EE. Leaves narrowly (not more than 1 cm.) peltate; stipules usually less than 1 cm. long.
- F. Bracts subtending the ♂ glomerules deeply concave; stamens 2 or 3; capsules with slender processes. 41A. *M. quadriglandulosa*, var. *variabilis*.
- FF. Bracts subtending the ♂ glomerules only slightly concave; stamens 3-15; capsules smooth or slightly and irregularly tuberculate, processed only in *M. induta*.
- G. Branchlets with new growth glabrous; ♂ inflorescence glabrous (only pubescent part of plant mentioned is the sparsely pilose midrib on the lower surface of the leaves); primary veins 2-4 pairs above the basal ones. 43. *M. hoffmannii*.
- GG. Branchlets with new growth and inflorescences tomentose; primary veins 5-9 pairs above the basal ones.
- H. Ovary 2- or 3-locular, mostly 2-locular.
- I. Leaves at maturity almost glabrous on the lower surface; capsules mostly 1-locular, rarely 2-locular. 44. *M. versteeghii*.
- II. Leaves at maturity tomentose on the lower surface.
- J. Stamens 3-5, anthers with a few brownish wrinkled hairs attached to them; pubescence of the lower surface of the leaves uneven under a lens. 45. *M. trichanthera*.
- JJ. Stamens 10-15, anthers glabrous; pubescence of the lower surface of the leaves even (almost like a thin felt) under a lens; capsule processed or smooth. 46. *M. induta*.
- HH. Ovary 1-locular, rarely 2-locular.
- I. Leaves elliptic-ovate, almost glabrous at maturity; stipules oblong-lanceolate. 44. *M. versteeghii*.
- II. Leaves subrhombic- or suborbicular-ovate, somewhat tomentose on the lower surface; stipules linear-lanceolate. 47. *M. albescens*.

DD. Leaves apeltate.

E. Stamens 20 or less.

F. Capsules with processes; stamens 2 or 3.

G. Bracts subtending the ♂ glomerules entire.

H. Bracts ovate, 3–5 mm. long, deeply concave, glabrous.

...41A. *M. quadriglandulosa*, var. *variabilis*.

HH. Bracts densely hairy outside, about 1.3 mm. long, acuminate, somewhat clasping the rachis.48. *M. nova-guineensis*.

GG. Bracts subtending the ♂ glomerules dentate, puberulous.49. *M. subpeltata*.

FF. Capsules smooth; stamens 17.

G. Bracts subtending the ♂ glomerules dentate or lacinulate.

H. Bracts dentate with short (0.3–0.5 mm.) teeth; ovary 1- or 2-locular.

.....50. *M. ovatifolia*.

HH. Bracts lacinulate with laciniae 1–2.5 mm. long.

I. Ovary 1-locular.52. *M. polyadenia*.

II. Ovary 2-locular.51. *M. fimbriata*.

GG. Bracts subtending the ♂ glomerules entire.

H. Lower surface of the leaves covered with rusty brown tomentum.

.....45. *M. trichanthera*.

HH. Lower surface of the leaves not tomentose.

I. Leaves sparsely pilose or setulose on the upper surface, short-villous beneath; stamens 3.53. *M. villosula*.

II. Leaves glabrous on the upper surface and mostly glabrous beneath; stamens 5–17.

J. Stamens 10–17.

K. Leaves caudate-acuminate with the acumen 1.5–3 cm. long, 3-nerved at the base with 4–6 additional pairs of primary veins above the basal ones, not maculo-glandular on the upper surface.54. *M. gracilis*.

KK. Leaves obtusely cuspidate-acuminate, pinnately veined with 8–11 pairs of primary veins, maculo-biglandular on the upper surface at the base.55. *M. haplostachya*.

JJ. Stamens 5–9.

K. Leaves at the base suddenly contracted to about 2–2.5 mm. broad and extended down-

ward 2.5–3 mm. to join the petiole. . . 56. *M. lanceolata*.

KK. Leaves obtusely cuneate or obtuse at the base.

L. Leaves very small, 2.5–4.5 cm. long, 0.9–1.3 cm. broad; ♂ inflorescence simple or sparsely branched.

. 57. *M. kostermansii*.

LL. Leaves larger, 6–17 cm. long, 2–11 cm. broad; ♂ inflorescence branching from near the base (known only in the varieties).

. 58. *M. inermis*.

EE. Stamens 32–59. 59. *M. pleiostemona*.

1. *Macaranga belensis* sp. nov.

Arbor 10–12 m. alta; ramulis novellis, foliis novellis petiolis, stipulis, et inflorescentiis molliter pilosis vel subvillosulis, pilis 1.3–2 mm. longis; laminis firme chartaceis, 5–13 cm. longis, 2–5.5 cm. latis, ovatis, sensim longe acuminatis, acumine 1–2.5 cm. longo, versus basin angustatis, basi retusis vel emarginatis et supra maculari-2–6-glandulosis, maturis supra glabris olivaceis, subtus pallidioribus costa venisque paulum pilosis, utrinque flavo-granulari-glandulosis, inconspicue trinerviis vel penninerviis, venis primariis utrinsecus costa 6–9 oblique adscendentibus subtus prominulis et in axillis crispe pilosulis, venis secundariis et rete manifestis; petiolo 1–3.5 cm. longo; stipulis connatis cito caducis 1.1–2.3 cm. longis; inflorescentiis ♂ simplicibus 5–7.5 cm. longis (incl. basi 1–2.5 cm. nudis) dissite glomerulo-florigeris, bracteis extus dense pilosis, intus non patellari-glandulosis, ovatis inferioribus longe acuminatis ca. 7–10-floris; floribus ♂ pilosis et granulati-glandulosis; calyce tripartita, lobis circiter 2 mm. longis; staminibus 11–24, antheris 4-ocularibus; floribus ♀ ignotis.

NETHERLANDS NEW GUINEA: common in secondary forest, Bele River, 18 km. NE. of Lake Habbema, alt. 2200 m., *Brass 11212* (TYPE, ♂, A). Nov. 1938 (tree 10–12 m. high).

The basal glands of the leaves are below the two basal lateral veins, which extend only about one-third of the length of the leaf. These are not more prominent than the other lateral veins, but in the larger leaves the basal laterals support secondary veins more remote than the upper laterals, hence suggesting three-nerved leaves.

2. *Macaranga eymae* sp. nov.

Habitus ignotus, probabiliter frutex vel arbor; ramulis teretibus apicem versus subadpresse villosa-hirsutis, pilis leoninis; laminis firme chartaceis, 13–30 cm. longis, 3.8–11.7 cm. latis, lanceolatis vel anguste ovatis sensim

acuminatis, acumine 1.5–3 cm. longo, basi breviter cordatis, supra prope apicem petioli glandulis maculiformibus 4–6 ovalibus instructis, margine integris vel undulatis, novellis dense villosulo-hirsutis, maturis glabrescentibus, supra in costa tantum, subtus costa et venis et venulis villosulo-hirtellis, supra minute bullatis, pinnatinerviis vel basi breviter trinerviis, venis primariis utrinsecus costa 18–25 oblique adscendentibus prope marginem arcuatim conjunctis utrinque perspicuis; petiolo 1.5–5.5 cm. longo subadpresso hirtello; stipulis connatis, 3–6.5 cm. longis, cito caducis, adpresso villosulo-hirsutis; inflorescentiis hirtellis; ♂ 7–9 cm. longis, 2.5–3 cm. pedunculatis, ramis inferioribus ad 5 cm. longis adscendenti-patentibus, bracteis sub ramos lineari-lanceolatis caducis, bracteis florigeris persistentibus e basi dilatata angustatis deinde in laminulam fere semiorbicularem intus patelliformi-pluriglandulosam protractis, supra basin ca. 2 mm. longis, 5–7-floris; calyce ♂ sub anthesin fere 1.5 mm. longo, sepalis 3 ovatis, staminibus 3–7 (saepo 4), antheris 4-locularibus; ♀ simplicibus, pedunculo 3–5 cm. longo, apice flores 1 vel 2 proferentibus, bracteis oblongis basin versus petioliformi-angustatis, circiter 1 cm. longis, parte superiore intus patelliformi-pluriglandulosis; floribus ♀ ca. 1 cm. pedicellatis, calyce tubuloso, 6.5 mm. longo, parte inferiore subglobosa ovarium arcte cingente, ca. 5 mm. diam., parte superiore brevi truncata, deinde rumpente et deciduo; ovario globoso dense adpresso molliter echinato, hirtello, 2-loculare, stigmatibus 2 linearibus plumosis circiter 6 mm. longis; capsula immatura sine echinis 9 mm. diam., 6 mm. alta, echinis numerosis subulatis leviter curvatis pilosis, fere 5 mm. longis.

NETHERLANDS NEW GUINEA: Wissel Lake region, SW. corner of Lake Paniai, Camp Moeie, alt. 1750 m., *Eyma* 4966 (♂ & ♀, A, TYPE; BO), July 28, 1949.

3. *Macaranga reiteriana* Pax & K. Hoffmann in Pflanzenr. 85 (IV. 147. XVIII): 185. 1924.

Tree 6–20 m. tall; young parts (branchlets, petioles, young leaves, stipules, and in a lesser degree inflorescences) brownish golden-hirtellous with hairs 0.7–1 mm. long and antrorsely subappressed; the slender branchlets glabrate; stipules connate and caducous, 2.5–5 cm. long; petiole 1–2.5 cm. long; leaf-blades firmly chartaceous or thinly coriaceous, 4.5–10 cm. long, 1.5–4 cm. wide, lanceolate or ovate-lanceolate, entire and acuminate, obtuse at the base, above near the attachment of the petiole dotted with 2–6 small flat dark glands, glabrous above except for the sparsely hairy midrib, beneath more densely hairy on the midrib and veins and densely punctate with brownish depressed minute glands, 8–10 primary veins on either side of the midrib, with secondary veins and reticulations easily seen on the upper surface but inconspicuous below; the simple ♂ inflorescence 4–6 cm. long with scattered glomerules of flowers, the bracts subtending the glomerules about 2 mm. long with shallow concave base about 1 mm. deep, elongated on the dorsal side to form a shortly spatulate lobe with the apex patelliform-glandular (many minute glands) within and about equal-

ing the narrowed portion in length; ♂ flower with 3 or 4 sepals 0.5–0.8 mm. long and granulo-glandular; stamens 3 or 4, the anthers 3- or 4-locular; ♀ flower (not seen) solitary and bibracteate at the apex of the peduncle; calyx fusiform enclosing the densely glandular ovary, the style plumose.

NETHERLANDS NEW GUINEA: occasional on slopes in primary forest, 15 km. SW. of Bernhard Camp, Idenburg River, alt. 1510 m., *Brass & Versteegh 11977* (♂, A), Jan. 1939 (tree 19 m. tall, diam. 35 cm., crown not wide-spreading; flowers grey; bark 5 mm. thick, black, fairly smooth; sapwood rose, heartwood red-brown).

This staminate collection agrees well with the original description; the only differences I find are that none of the leaves in the collection cited is broader than 2.7 cm., whereas the maximum width given in the original description is 4 cm., and that the anthers are as often 3-loculed as 4-loculed, not mostly 4-loculed. These features are only indicative of variation, and not in any way of specific value. The terminal bud of this species is long and very narrow (3 or 4 mm.), much like that of *M. longestipulata* (Kurz) Muell. Arg. from Ternate in the Moluccas. Unfortunately only the pistillate form of the latter has been collected, and apparently from the original description of *M. reiteriana* only the very young pistillate flowers of this are known. As between the two species there are no processes on the ovary, whereas they are characteristic of the fruit of *M. longestipulata*.

4. *Macaranga cucullata* J. J. Smith in *Nova Guin.* 8: 237, *t.* 60. 1910; l.c. 789. 1912. — Pax & K. Hoffmann in *Pflanzenr.* 63 (IV. 147. VII): 369. 1914. *

Tree up to 8 m. high; young branchlets, petioles, peduncles, and branches of the inflorescence yellowish hirsute with (sometimes stiffish) hairs 1–6 mm. long, quickly glabrescent or glabrate; stipules connate, caducous, up to 13 cm. long, appressed hirsute (sometimes sparsely so) on the outer surface; petioles 8–43 cm. long; leaf-blades large and subcoriaceous, 18–63 cm. long, 14–44 cm. broad, 3–5-lobed or entire and elliptic-ovate with the apex of entire leaves or lobes abruptly and narrowly 1–4 cm. acuminate, distantly callose-dentate on the margin, broadly rounded on either side of the deeply cordate base and bearing at the sinus 2 narrow and rounded-undulate auricles with a few flat oval glands on the upper surface, strongly 3-nerved at base with 12–16 pairs of prominent primary veins above the basal ones, the secondary veins almost parallel; young leaves densely lanate-hirsute on the upper surface, later glabrate, densely and minutely dark-glandular beneath with the venation appressed hirtellous; ♂ inflorescence paniculate, 13–17 cm. long, the peduncle 3–5 cm. long; primary bracts stipule-like, caducous; bracts subtending the glomerules attached to the rachis forming a cup-like base 1–1.5 mm. wide and deep, the free part an oblong or spatulate-obovate lobe 1–1.5 mm. long, pilose outside, bearing a single orbicular patelliform gland within; ♂ flowers short-pedicellate; sepals 3 or 4, ovate, concave, 0.5–0.7 mm. long; stamens 3–7 with 2-locular anthers; ♀ inflorescence short, 3–3.5 cm. long, few-flowered,

hirsute; capsule depressed quadrangular-globose, densely glandular, with pubescent subulate processes 2–2.5 mm. long.

NETHERLANDS NEW GUINEA: primary forest, North River, *Versteeg 1064* (♂, BO, TYPE), May 1907; primary forest, North River, *Von Roemer 431* (♀, BO), Oct. 1909; common in seral rain forest on edge of river floodplain, Bernhard Camp, Idenburg River, alt. 50 m., *Brass 13826* (♂, A), April 1938 (tree 6–8 m. high with very large cordate leaves about 55×44 cm.).

PAPUA: occasional in subseral rain forest on river bank, Palmer River, 2 miles below junction Black River, alt. 100 m., *Brass 7256* (♂, A), July 1936 (small tree 3 or 4 m. high with erect branches; leaves 63×39 cm., red beneath; panicles red, anthers white).

The only ♀ collection is *Von Roemer 431*. The ♂ inflorescences of the other specimens are so much alike that I feel sure that they belong to a single species. It should be noted, however, that the leaves of the *Brass* collections are entire and larger, whereas those of *Versteeg 1064* and *Von Roemer 431* are 3–5-lobed mostly. In view of the leaf variation shown in the excellent series of specimens belonging to *M. aleuritoides* F. Muell., cited above, the presence or absence of lobes cannot be regarded as a specific character. *Brass 7256* is more nearly glabrous than the other specimens; on the other hand *Brass 13826* is more hairy (with irritant hairs) than any of the others; here, even on the upper surface of the leaves, are scattered longish hairs, and the upper branchlet is almost hispid.

5. *Macaranga pleytei* sp. nov.

Arbor parva 8 m. alta; ramulis teretibus novellis setulosis, setulis patentissimis flavescentibus ca. 4 mm. longis; laminis novellis, petiolis, stipulis et pedunculis dense hirtello-setulosis, setulis saepissime patentissimis 2.5–4 mm. longis et pilis 0.2–0.5 mm. longis intermixtis; laminis chartaceis 6.5–14.5 cm. longis, 4.5–12 cm. latis, orbiculari-ovatis abrupte acuminatis, acumine 0.5–1 cm. longo, basi 0.6–1.9 cm. peltatis, supra in nervis inter insertionem petioli et marginem basalem glandulis maculiformibus 4–6 instructis, in sicco margine revolutis, glabrescentibus, maturis supra sparsim setulosis et interdum leviter rugulosis, subtus minute cerino-glandulosis etiam costa et venis et venulis hirtellis, palmatinerviis, venis primariis supra basalibus utrinsecus costa 7–9 oblique adscendentibus prominulis, secundariis et rete perspicuis; petiolo 4.5–11 cm. longo; stipulis connatis cito caducis, 3–5 cm. longis, setulis subadpresse adscendentibus; inflorescentiis ♂ paniculatis, 11–18 cm. longis, pedunculo 8.5–11 cm. longo, rhachi et ramis hirtellis, ramis inferioribus 2.5–4 cm. longis; bracteis sub ramos breviter triangularibus acuminatis, bracteis florigeris ca. 13-floris, glomerulos non superantibus rhachidem semiamplectentibus semiobiculari-ovatis apiculatis, parte superiore intus patellari-pluriglandulosus; floribus ♂ saepissime alabastris, extus pauciglandulosus; calyce tripartita; staminibus 4, antheris 3-ocularibus; floribus ♀ ignotis.

NETHERLANDS NEW GUINEA: Misool Island: in thinned forest near Fakal, alt. 40 m., *Pleyte 1117* (♂, A, TYPE; BO), Oct. 7, 1948 (tree 8 m. tall, 6 cm. diam., flowers yellow).

Although the pistillate plant of this species is not known, the connate stipules, the 3-locular anthers, the leaf-venation, and the somewhat coarse pubescence suggest a relationship with the section *Dimorphanthera*. It is readily distinguished from the other species of this section by the peltate leaves.

6. *Macaranga aleuritoides* F. Mueller, Descr. Notes Pap. Pl. 2: 21. 1876. — Pax & Hoffmann in Pflanzenz. 63 (IV. 147. VII): 366. 1914.

Macaranga riparia Engler in Bot. Jahrb. 7: 463. 1886; Forschungsr. Gaz. 35, t. 11. 1888. — K. Schumann & Lauterbach, Fl. Deutsch. Schutzgeb. Südsee 397. 1900. — J. J. Smith in Nova Guin. Bot. 8: 235. 1910; l.c. 789. 1912.

Tree up to 20 m. high; young branchlets, stipules, petioles, peduncles, and branches of the inflorescence puberulous and appressed-pilose with hairs 0.6–1.7 mm. long, quickly glabrate; stipules connate, caducous, 3.5–9 cm. long; petioles 1–38 (usually 5–15) cm. long; leaf-blades often large and subcoriaceous, 13–45 cm. long, 7–42 cm. wide, sometimes entire and ovate but usually with 3 erect-spreading and narrowly acuminate lobes, the middle one triangular-ovate and much larger than the oblique, mostly entire (occasionally bilobed) lateral ones, inconspicuously callose-dentate on the margin or entire, truncate to cordate or in a few instances rounded at the base and bearing at the apex of the petiole 2 rounded-undulate auricles with a series of 1–4 flat oval glands above often extending to the blade, strongly 3-nerved at the base with 10–18 less prominent pairs of primary veins obliquely spreading-ascending and shortly arcuate just within the margin and joined throughout by distinct and almost parallel secondaries, the latter connected in turn by finer reticulations; the upper surface of the young leaves cinnamon-colored tomentose becoming glabrate, the lower remaining permanently puberulous and rather closely dark glandular-punctate; ♂ inflorescence paniculate, 7.5–24 cm. long including the compressed 1–6 cm. peduncle, the primary bracts stipule-like and caducous, the bracts subtending the glomerules 2–5 mm. long, linear, dilated at the apex and here bearing a single orbicular gland within; ♂ flowers almost sessile, the sepals 3, ovate, the stamens 5–15, the filaments exerted, the anthers 3-locular; ♀ inflorescence mostly branching (sometimes simple), 5.5–29 cm. long with the compressed 3–8 cm. peduncle, the primary bracts stipule-like, the secondary ones variable, lanceolate or linear and narrowed at the base, within variously dotted along the margin or towards the apex with orbicular glands, outside pilose; calyx of ♀ flower pilose, 6–8 mm. long, subglobose at the base and cylindrical in the upper part with a truncate apex, quickly deciduous, the plumose-papillose 2 or 3 styles 0.8–2 cm. long and recurved at the apex, the subglobose capsule 2- or 3-locular, ca. 1.5 cm. diam., densely glandular and bearing minutely hairy subulate processes 3 or 4 mm. long.

MOLUCCAS: Key Islands, West Elal, *Jensen* 342 (♂, A), May 1922.

NETHERLANDS NEW GUINEA: Pionier bivouac, alt. about 50 m., *Docters van Leeuwen* 9373 (♂, A, BO), June 1926; same camp, *Van Eechoud* 104 (sterile, BO), Nov. 1939; Albatros bivouac, alt. 50 m., *Docters van Leeuwen* 9629 (♀, BO), July 1926; near Prauwen bivouac, alt. 90 m., *Lam* 1037 (♂ & ♀, BO); Hollandia, alt. about 20 m., *Gjellerup* 310 (♂, BO), Aug. 1910; swampy forest, Ransiki, Vogelkop, alt. 10 m., *Kostermans* 2895 (♂, BO), Aug. 1948; on edge of rain forest Nabire, *Kanehira & Hatusima* 11421 (♀, A, BO), Feb. 1940; common in rain-forest seral growths on ground seldom flooded, Bernhard Camp, Idenburg River, alt. 50 m., *Brass* 13823 (♂ & ♀, A), April 1939 (tree 6–8 m. high; material from both ♂ and ♀ trees); Bernhard Camp, alt. 50 m., *Meyer-Drees* 428 (♀, BO), July 1938. Misoal: in thinned forest at Fakal, alt. 50 m., *Pleyte* 960 (♂, A, BO), Sept. 20, 1948 (tree 8 m. high, 10 cm. diam.; flowers dirty yellow); west of Fakal, alt. 30 m., *Pleyte* 1124 (♂, A, BO), Oct. 1948 (tree 10 m. high, 10 cm. diam.). Aroe Islands: primary forest and thickets, Poelau Wokam, Dosinamalaoe, *Burwalda* 5044 (♂, A, BO), 5046 (♀, A, BO), May 1938; same locality, Neth. Ind. For. Serv. *bb.25314* (♀, A), May 1938.

PAPUA: Palmer River, 2 miles below junction Black River, alt. 100 m., *Brass* 7284 (♀, A), July 1936 (dioecious tree 10 m. high; this and *Homalanthus* species the dominant species in rain-forest second growths); plentiful in seral shrubberies on muddy river banks, Oroville Camp, Fly River (30 miles above D'Albertis Junction), *Brass* 7435 (♂, A), Aug. 1936; plentiful on river banks flooded by tides, Lower Fly River, east bank opposite Sturt Island, *Brass* 8186 (♂, A), 8187 (♀, A), Oct. 1936; on old farm lands, Buna, *Lane-Poole* 164 (♂, BR), July 1922; forest, Koitaki, alt. about 450 m., *Carr* 12819 (♂, A, BM), July 1935; rain-forest second growth, Kubuna, alt. 100 m., *Brass* 5636 (♀, A, NY), Dec. 1933; Ihu, Vailala River, *Brass* 904 (♀, A), Feb. 1926; Bomgwina River, *Brass* 1622 (♀, A), June 1926.

NORTHEAST NEW GUINEA: mountain bush, Boana, alt. about 1050 m., *Clemens* 8306 (♂, A), June 1938; Boana, alt. 750 to 1350 m., *Clemens* 41465 (♀, A), May–Nov. 1940; mountain bush above Markham River, vicinity of Kajabit Mission, alt. about 600 m., *Clemens* 10893 (♂, A), Aug.–Dec. 1939; Bulu, *Schlechter* 16078 (♂, A), May 1907; Kenejia, alt. 150 m., *Schlechter* 18435 (♂, A), Oct. 1908; forest bank of Kerame River, 25 miles above Sepik River, *Herre* 331 (♀, BO, NY); on rain-forest margin, Yalu, *White, Dadswell & Smith* NGF 1648 (♀, A, BR, LAE); in brown sandy loam on alluvial flat on bank of Munim Water, Yalu, alt. about 30 m., 2nd Austral. For. Surv. Co. NGF 275 (♀, A, BR, LAE), July 1944; between Lae and Yalu, *White, Dadswell & Smith* NGF 1519 (♀, BR), July 1944; near Aitape, *Smith* NGF 1216 (♀, A, BR, LAE), Jan. 1945.

BISMARCK ARCHIPELAGO: New Britain: in Nodup area, Gazelle Peninsula, *Waterhouse* 237 (♀, NY), May, June 1934. Duke of York Is., without further locality, *Bradtke* 339 (sterile, BR), 1918.

SOLOMON ISLANDS: Bougainville: Torokina, *Robinson & Volk* NGF 818 (♀, A, BR, LAE), Jan. 1945; Kieta, alt. 80 m., *Kajewski* 1576 (♀, A), Mar. 1930; Kugu-maru, Buin, alt. 150 m., *Kajewski* 1804 (♀, A, BO), June 1930; Karngu, Buin, *Kajewski* 2227 (♂, A), Oct. 1930. San Cristobal: Waimamura, *Brass* 2579 (♂ & ♀, A), Aug. 1932.

This common species of second-growth forest shows great variability in the size of the leaves and the length of the petioles; a few leaves are entire, and some of the very large ones have the lateral lobes somewhat bilobed, although they are only 3-nerved at the base (cf. *Gjellerup* 310, *Docters van Leeuwen* 9373, *White*, *Dadswell & Smith* NGF 1648, *Clemens* 10893, *Schlechter* 16078, *Herre* 331, and *Brass* 13823).

The species is readily recognized by the three-lobed leaves with small rounded auricles close to the base of the petiole, the long apical bud covered by the connate stipules, the linear bracts (with an orbicular gland at the apex) subtending the glomerules of ♂ flowers, and the three-locular anthers. The single specimen cited from the Moluccas is the only one that I have seen from outside the Papuasian area.

7. *Macaranga papuana* (J. J. Smith) Pax & K. Hoffmann in *Pflanzenr.* 63 (IV. 147. VII): 368. 1914.

Macaranga hispida var. *papuana* J. J. Smith in *Nova Guin. Bot.* 8: 234. 1910.

Macaranga ovalifolia. Ridley in *Trans. Linn. Soc. II. Bot.* 9: 148. 1916. — Pax & K. Hoffmann in *Pflanzenr.* 85 (IV. 147. XVII): 186. 1924.

Tree 7–17 m. high, 30–32 cm. diameter; branchlets tomentulose-puberulous, tardily glabrescent; stipules connate, caducous, 2–5.5 cm. long, sericeous outside; leaf-blades chartaceous, 7.5–18 cm. long, 5.5–15 cm. wide, ovate with entire margin, and acuminate at the apex, rounded or truncate or slightly cordate at the base and bearing at the apex of the petiole 2 rounded undulate auricles with 1–3 oval glands above, pinnately veined (3-nerved at the base) with 8–12 primary veins obliquely ascending from either side of the midrib, the secondary venation distinct on the lower surface, glabrous above except for the puberulous midrib, minutely dark-glandular and crisply puberulous beneath on all veins; young leaves densely short-pilose with hairs scarcely 1 mm. long; petiole 2–10 cm. long, tomentulose-puberulous like the branchlets; ♂ inflorescence 10–24 cm. long (including peduncle 1.5–3 cm.), tomentulose-puberulous or pilose, sparsely 2–6-branched with 2 or 3 long slender branches bearing dense many-flowered glomerules about 5 mm. apart; bracts subtending the glomerules 3-lobed, pilose on the outside, with the two lateral lobes rounded and the dorsal lobe suborbicular and patelliform-glandular within; ♂ flowers puberulous and sometimes granulo-glandular on the exposed part, the pedicels hairy, 1 mm. long; calyx 0.5–0.7 mm. long, 3-parted; stamens 4–8 with 3-locular anthers; ♀ inflorescence simple, immature, few-flowered; axis 2.5–5 cm. long, the bracts subtending the flowers ovate and patelliform-glandular within; calyx sparsely pilose, hardly 4 mm. long, truncate at the apex, deciduous, the ovary 2-locular, the 2 styles about 5 mm. long, pubescent on the dorsal surface and densely papillose above; capsule about 1 cm. diameter (probably immature), granulo-glandular and rather closely covered with pubescent processes 2–4 mm. long.

NETHERLANDS NEW GUINEA: Merauke River, *Jaheri s. n.* (♂ & ♀, BO, TYPE), Mar. 25, 1901; Camps I to III, Wollaston Exped., *Kloss s. n.*

(type of *M. ovalifolia* Ridl., ♂, BM; photo A); Babo. *Matatula* 19 (Neth. Ind. For. Serv. bb.21815) (♀, BO); Hollandia, Bernhard Camp, about 50 m. alt., *Meyer-Drees* 471 (Neth. Ind. For. Serv. bb.25718) (♂, A, BO).

PAPUA: Central Division, Mageri near Sogeri, *G. Angell* NGF 4197 (♂, A).

This species is undoubtedly closely related to *M. hispid*a (Blume) Muell. Arg., but it is readily distinguished by the auricles and the lack of a deep sinus so characteristic of the Moluccan species. Also it is less hispid.

8. *Macaranga tessellata* Gage in Nova Guin. Bot. 12: 481, *t.* 186. 1917. — Pax & K. Hoffmann in Pflanzenr. 85 (IV. 147. XVII): 184 (*sphalm tesselata*). 1924.

Tree about 16 m. high; apices of the branchlets, young leaves, stipules, and petioles densely hirtellous with hairs 0.4–1 mm. long, soon glabrate; stipules connate, caducous, 1.5–3 cm. long; petioles 1.7–3.5 cm. long; leaf-blades chartaceous, 13–18.5 cm. long, 6.5–10 cm. broad, elliptic-ovate with undulate or slightly dentate margin, somewhat narrowed at both ends, rather abruptly 1–1.5 cm. acuminate at the apex and shallowly cordate or rounded at the base, on the upper surface near the attachment of the petiole bearing 2 small oval glands or one or none, glabrous above except for the pubescent midrib and primary veins, hirtellous beneath on the midrib and veins and strewn with minute dark glandular dots, 8 or 9 primary veins (fairly prominent beneath) on either side of the midrib above the 3-nerved base, the secondaries prominulous and the reticulation visible to the naked eye; ♂ inflorescence in a few-branched panicle (only young ones in specimens studied) with pilose (hairs 0.5 mm. long) axis, the glabrous ♂ flowers glomerulate in the pubescent axis of the ultimate bracts, the latter about 2 mm. long with 2 basal lobes forming a shallow saucer-like cavity and the dorsal part elongating into a rounded or triangular-ovate lobe densely patelliform-glandular within; sepals about 0.5 mm. long, the stamens 3, with 3-locular anthers; ♀ inflorescence (not seen) short and bearing a few sessile crowded flowers; calyx about 3.5 mm. diameter and irregularly 3–5-lobed, tomentose on the outer surface, the styles 2; capsule compressed-globose, bearing yellowish tomentose subulate processes about 5 mm. long.

NETHERLANDS NEW GUINEA: North River near Bivak Island, *Pulle* 132 (♂, BO, TYPE).

This species, associated by Pax & K. Hoffmann with *M. nova-guineensis* J. J. Sm. in the section Echinocarpae, has four characters in common with the section Dimorphanthera; they are: connate stipules, 3-locular anthers, the elongate dorsal part of the bracts subtending the staminate glomerule patelliform-glandular within, and fruits with processes. The stipules were originally described as lanceolate and caducous, inferring that they are free. In the two specimens at hand the stipules are found only on the ter-

minal buds. I have detached one of the buds and soaked it to verify the fact that its cover is a single scale rather than two.

9. *Macaranga platyclada* Pax & K. Hoffmann in Pflanzenr. 68 (IV. 147. XIV): 30. 1919.

Macaranga roemerii Pax & K. Hoffmann in Pflanzenr. 85 (IV. 147. XVII): 185. 1924.

Tree to 26 m. high, 35 cm. diameter; young branchlets, young leaves, petioles, stipules, and inflorescences densely velvety-pilose or subtrigose with hairs 0.8–1.2 (–1.8 on stipules, and appressed) mm. long, glabrescent; stipules connate, caducous, 5–11 cm. long; petioles 8–16 cm. long; leaf-blades subcoriaceous, 11.5–33 cm. long, 7–22 cm. broad, entire or undulate and ovate or subrhombic-ovate or with 3 erect and narrowly acuminate lobes, with the middle lobe broadly triangular and up to 8 cm. acuminate and separated from the narrow laterals by wide sinuses, very shallowly cordate or truncate or rounded at the base, without basal glands on the upper surface, palmately 5-nerved with 7–9 ascending pairs of primary veins above the basal ones, becoming glabrescent above and dotted with scattered minute yellow glands, also sometimes minutely bullate, shortly pilose on all veins beneath and sprinkled with yellow glands, the secondary venation and reticulation distinct; bracts enclosing ♂ inflorescence stipule-like but not connate; panicle up to 22 cm. long, the compressed peduncle 4–7 cm. long, branches opposite, or 2 or 3 of different lengths clustered at a single node and usually subtended by lanceolate or linear acuminate bracts, the latter 0.5–2.5 cm. long and bearing several patelli-form glands (in one instance the lowest branches subtended by a pair of lanceolate leaves 10 cm. long and 2.5 cm. wide with acumen 3 cm. long and petiole 5 mm.); the glomerules subtended by obtusish and oblong or slightly obovate bracts up to 5.5 mm. long, biauriculate at the base, patelli-form-glandular and pubescent on the upper surface; ♂ flowers with 3 granulo-glandular and pubescent sepals 1 mm. long, the stamens 4–7 with 3- and 4-locular anthers; ♀ inflorescence simple, up to 15 cm. long, bearing apparently sessile flowers at 2 nodes but fruit on pedicels 5–9 mm. long, each node subtended by bracts with the petiolar bases 5 mm. long, the lower node with lanceolate acuminate bracts up to 2 cm. long, the upper node with bracts oblong or ovate and obtuse about 1 cm. long, all patelli-form-glandular and pubescent on the upper surface; calyx of the ♀ flower densely pubescent and minutely glandular, 1.1–1.6 cm. long, globose at the base and about 4–5 mm. across, then somewhat narrowed into a tube bearing at the apex 5 narrow tapering lobes as long as the tube (sometimes lobes longer and tube very short), quickly deciduous; ovary 2- or 3-locular, the plumose papillose 2 or 3 styles with recurving apices up to 1.8 cm. long (including the 4–4.5 mm. connate base) and dorsally pubescent; fruit immature, densely granulo-glandular and covered with slender pubescent processes about 2 mm. long.

NETHERLANDS NEW GUINEA: frequent in rain forest, alt. 1630 m., *Brass & Versteegh 11936* (♂, A), Jan. 1939; in rain forest at 1700 m. alt., *Brass 12276* (♂, A), Jan. 1939; frequent in rather open rain forest on sides of ravines, alt. 1600 m., *Brass 12365* (♀, A), Jan. 1939; common seral tree on landslips in rain forest, alt. 1200 m., *Brass 12782* (♀, A), Feb. 1939.

With only the original description as a basis for comparison, I am unable to distinguish between *M. platyclada* and *M. roemeri*, although Pax & Hoffmann have assigned their two species to different sections. The collections above cited sometimes have lobed and entire leaves on the same specimen, illustrating the fact that, in palmately nerved leaves, entire leaves versus lobed leaves are not distinctive characters. In the specimens cited above, the upper surface of the leaves is softly pubescent and tends to be sparsely so. Although most of the anthers were 4-locular, some 3-locular anthers were also found.

10. *Macaranga fallacina* Pax & K. Hoffmann in *Pflanzenr.* 68 (IV. 147. XIV): 31. 1919.

Small tree 5–10 m. tall, apices of branchlets, stipules, and very young leaves ferrugineous tomentose-pilose; the stipules lanceolate, acuminate, 2–3 cm. long, free and caducous; petioles 6–28 cm. long, glabrescent; leaf-blades thinly coriaceous, 14–36 cm. long, 11–29 cm. wide, orbicular- or triangular-ovate with entire or sinuate margin, acuminate, the acumen 1–2.5 cm. long, rounded then truncate at the base and 1.5–6.5 cm. peltate, palmately 7-nerved with about 12 slightly curved primary veins above the basal ones obliquely ascending from either side of the midrib, bearing on the upper surface of the basal nerves (close to the insertion of the petiole) 3–5 flat oval glands, glabrous above, distantly and minutely dark-glandular beneath, glabrescent on the veins, the secondary venation distinct on both surfaces; the 2–3 cm. pedunculate ♂ panicles 8–12 cm. long and up to 8 cm. broad, puberulous; bracts at the base of the branches obovate, acute, carinate, 1–2 cm. long, ferrugineous-tomentose, not patelliform-glandular; bracts subtending the many-flowered glomerules about 2 mm. long, contracted from a broad base into an ovate blade patelliform-biglandular within; sepals 3, ovate, acute, and sparsely granulo-glandular; stamens 3–6 with 3-locular anthers; the 16–23 cm. pedunculate (peduncle scarred 2–10 cm. below the apex) ♀ inflorescence simple (?), bearing 3 or more fruits at the apex; ovary 2-locular; styles very broad (5 mm. long, 4 mm. broad), pubescent on the lower surface and very densely plumose on the upper, the papillae being about 2.5 mm. long and somewhat flattened; capsules immature, about 1 cm. diameter after being soaked, densely granulo-glandular, bearing deciduous pubescent processes 1.5–3 mm. long.

NETHERLANDS NEW GUINEA: van Gelder River, alt. about 100 m., *Docters van Leeuwen 9289* (♂, BO), May 1926; Albatros Bivouac, alt. about 60 m., *Docters van Leeuwen 9341* (♀, BO), June 1926; Motor Bivouac, alt. about 100 m., *Docters van Leeuwen 11057* (♂, A, BO), Nov. 1926; rain forest, Nabire, *Kanehira & Hatusima 11476* (♀, A, BO), Feb. 1940 (very rare).

The only authentic material which I have of this species is the carbon rubbing of the basal part of a leaf of an isotype which matches very well those of the collection cited above. It should be noted that in the staminate material which I have before me the apex of the bracts supporting the glomerules is very elongate and narrow rather than ovate, as in the original description. There are one or two small glands on the margin of these, whether they are patelliform I cannot say. The stamens are three and anthers three-locular; in the original description the stamens are three to six and the anthers three-locular. I regard these as variations within a species; without actual material for comparison I cannot place this material elsewhere than in this species.

11. *Macaranga salomonensis* sp. nov.

Arbor alta cortice cinereo; ramulis glabris; stipulis ovato-ellipticis 1.5 cm. longis, 0.9 cm. latis, concavis acutis, liberis fere glabris (apicem versus pilis paucis); petiolo 5.5–11 cm. longo glabro; laminis orbiculari-ovatis, 8.5–18 cm. longis, 5.5–11 cm. latis, breviter et late acuminatis vel acutis, basi 1.3–2.5 cm. peltatis, palmati-8-nerviis supra basales venis primariis 5–8 paribus prominulis, secundariis distinctis, novellis utrinque dense ferrugineo-lanato-tomentellis cito glabratis, maturis supra glabris subtus floccoso-tomentellis (fere glabris) et glanduloso-punctatis; ♂ inflorescentiis 6–17 cm. longis, pedunculo 2–7 cm. longo, glabro, ramulis 1.5–4 cm. longis floccoso-tomentellis deinde glabratis, bracteis florigeris basi 1.5 mm. concavis deinde ca. 2 mm. recurvis et crassiusculis semiorbicularibus intus glandulis patellaribus \pm confluentibus ca. 25-floris, pedicellis vix 1 mm. longis pubescentibus; sepalis 3 ovatis 1–1.3 mm. longis; staminibus 5–8, antheris 4-locularibus; ♀ inflorescentiis ca. 8 cm. longis valde maturis, tantum una capsula terminale reliqua, 2-loculari, tomentoso-puberula, 1.7 cm. lata, 1.5 cm. alta, 1.4 cm. crassa; echinis mollibus 5–7 mm. longis, seminibus $0.9 \times 0.8 \times 0.7$ cm., rugulosis.

SOLOMON ISLANDS: Y s a b e l : rain forests. Tiratona, alt. 600 m., *Brass* 3327 (♂ & ♀, A, TYPE), Dec. 1932 (very tall gray-barked tree, dioecious). Bougainville: rain forest, Koniguru, Buin, alt. 800 m., *Kajewski* 2038 (♂, A), Aug. 1930 (small tree up to 13 m. high; flowers on green stems supported by stiff bracts).

This species can be easily recognized by the practically glabrous branchlets, the densely tomentose new small leaves with glabrous petioles, the thickish recurved bracts (with at times confluent patelliform glands on the upper surface) subtending the glomerules of staminate flowers, and the deeply peltate leaves.

12. *Macaranga stenophylla* Pax & K. Hoffmann in Pflanzenr. 63 (IV. 147. VII): 371. 1914.

Branchlets slender with young parts at first ferruginous-tomentose then quickly glabrate; stipules not seen; petioles 4.5–7 cm. long, tomentulose; leaf-blades elliptic-ovate or oblong or oblong-lanceolate, acuminate, 12–18

cm. long, 6–7 cm. broad, rounded at the base and 0.7–1 cm. peltate, 3-nerved and shortly palmate-nerved, glabrous above and bearing several gland-like spots between the attachment of the petiole and the basal margin, reticulate beneath, also sparsely puberulous and granulo-glandular on the veins; ♂ panicles ferrugineous-tomentose; glomerules many-flowered; bracts tomentulose, triangular at base, then contracted and produced into a lanceolate apex patelliform-glandular within; calyx granulo-glandular and tomentulose; stamens 15 or 16 with 4-locular anthers.

The type, *Schlechter 17724*, was collected at an altitude of 1000 m., on Kani Mountains, Northeast New Guinea. Pax & K. Hoffmann note that only the young ♂ plant is known, but believe that a significant character is found in the narrow and peltate leaves.

13. *Macaranga rufibarbis* Warburg in Bot. Jahrb. 16: 21. 1893. — K. Schumann & Lauterbach in Fl. Deutsch. Schutzgeb. Südsee 397. 1900, in part. — Pax & K. Hoffmann in Pflanzenr. 63 (IV. 147. VII): 373. 1914.

Tree with varying amount of pubescence; young parts rusty tomentulose but very soon glabrate; stipules narrowly ovate, acuminate, 1.5 cm. long, glabrous or with a few hairs towards the apex or occasionally pubescent along the middle of the dorsal surface, caducous; petioles 2–5.5 cm. long, glabrate; leaf-blades 7–18 cm. long, 4–12 cm. broad, triangular-ovate and long-caudate with the narrow apex up to 4 cm. long, at the base rounded and narrowly (2–4 mm.) peltate or truncate and very narrowly and shallowly cordate, 2–6-maculo-glandular on the upper surface below or adjacent to the attachment of the petiole, dark granulo-glandular beneath, 3-nerved with 6–9 pairs of prominent veins above the basal ones, the secondary venation also prominent, the new leaves loosely rusty-tomentose but glabrous at maturity or with remnants of the pubescence along the midrib and around the attachment of the petiole beneath; ♂ panicle 5–12 cm. long, rusty-pilose with hairs seemingly clustered at times around the base of the branches and bracts; bracts subtending the glomerules 2 or 3 mm. long, usually triangular-ovate and obtusely acuminate, 1–2-patelliform-glandular on the upper surface, hairy beneath and granulo-glandular; sepals 3, ovate, 1.5 mm. long, pilose and sparsely granulo-glandular towards the apex; stamens 11–18 with 4-locular anthers; ♀ inflorescence 5–12.5 cm. long, simple, loosely rusty-tomentose, then glabrate; flowers clustered near the apex and also at a node about 2–5 cm. below the apex; bracts ovate, about 5 mm. long, 3–4 mm. broad, patelliform-glandular on the upper surface and pilose beneath, caducous; calyx appressed-pilose then glabrate, globose-pyriform, about 4 mm. high, truncate, splitting into 2 or 3 parts and falling; ovary 2-locular, granulo-glandular and covered with hairy processes which in fruit may be 2.5–3 mm. long, the styles about 3 mm. long, slenderly papillose or short-plumose; capsule about 1 cm. broad.

NORTHEAST NEW GUINEA: Wantoat, *Clemens 40925* (♂, A), Feb. 5, 1940; same locality, alt. 1050–1800 m., *Clemens 11198bis* (♀, A), Feb. 28, 1940;

mountain bush, Sarawaket, alt. 1200–1800 m., *Clemens* 8308A (♀, A), June 15–18, 1938 (tree 5 inches diameter; fruit garnet or wine-red); Samanzing, alt. 1650–1800 m., *Clemens* 9205 (♀, A), Nov. 5, 1938; Sambanga, alt. 1500–1800 m., *Clemens* 7740 (♀, A), Nov. 25, 1937 (tree or shrub 12–15 ft., with brown fruit).

Clemens 7740 is much more pubescent than the other specimens, but I believe this indicates a newer growth. Only the staminate collection has narrowly peltate leaves, but the prominent venation and the pubescence are similar in all the collections cited.

***Macaranga rufibarbis* var. *tenella* (Pax & K. Hoffmann), comb. nov.**

Macaranga tenella Pax & K. Hoffmann in *Pflanzenr.* 63 (IV. 147. VII): 379. 1914.

This variety is characterized by the lanceolate or linear-lanceolate leaves 9–17 cm. long, 2–6 cm. broad, with rounded or broadly cuneate and minutely cordate base, 2- or 3-maculo-glandular on the upper surface near the attachment of the petiole; bracts beneath glomerules of flowers in the ♂ panicle dilated at the base, then narrowed a little and above broadened into a lanceolate apex 1–2-patelliform-glandular on the upper surface, beneath pubescent and granulo-glandular; sepals 2 or 3, stamens 8–10 with 4-locular anthers.

NORTHEAST NEW GUINEA: Finisterre Mt., alt. 1300 m., *Schlechter* 19101 (♂, A), January 1909.

This collection differs from those cited for the species in being somewhat more glabrous. However, wherever pubescence remains on the specimens it is apparently the same type in all. The leaves are narrower and, although not so stated in the original description, they are maculo-glandular. The bracts in the species do not show the narrowed part above the dilated base, a character noted in the specimen cited above; there are also somewhat fewer stamens here, although one cannot say that more material wouldn't show overlapping numbers.

14. *Macaranga decipiens* sp. nov.

Frutex 2–3 m. altus; ramulis, stipulis, foliis novellis, et axibus inflorescentiarum breviter hirtellis, pilis albis ca. 0.5 mm. longis; stipulis linearibus vel lineari-lanceolatis, 3–5 mm. longis, caducis; petiolo 1.5–3.5 cm. longo; laminis oblongo-lanceolatis, variabilibus, 10.5 × 4 cm., 12 × 3 cm., 15 × 7 cm., 20 × 9 cm., 25 × 7 cm., utrinque angustatis, apice acutis vel acuminatis, basi rotundato-cuneatis, undulatis, supra glabris, costa et venis breviter pilosis, subtus granuloso-glandulosis, costa et venis dense rete sparsim pilosis, penninerviis, venis primariis 9–12 paribus oblique patentibus deinde prope marginem curvantibus et anastomosantibus, rete laxo; ♂ paniculis pauci-ramosis gracilibus, usque 5.5 cm. longis; ♂ floribus plerumque apice ramulorum dense confertis; bracteis sparsim pilosis, linearibus 2–2.5 mm. longis glomerulos excedentibus, basi dilatatis, apice leviter dilatatis et intus patellari-1-glandulosis; sepalis 3 vix 0.5 mm.

longis, pauce granuloso-glandulosis, staminibus 2–4, antheris 4-locularibus; ♀ inflorescentia 5–10 cm. longa, simplici; bracteis petiolulatis apicem versus lineari-lanceolatis, 6–10 mm. longis, intus patellari-glandulosis; calyce non viso; ovario 2-loculari echinis pubescentibus tecto, stylis ca. 3–5 mm. longis, plumosis; capsula immatura, echinis usque 1 mm. longis.

NETHERLANDS NEW GUINEA: rain forest, Waren, 60 miles south of Manokwari, alt. 20 m., *Kanehira & Hatusima* 13256 (♂, A, TYPE; BO), Mar. 1940 (shrub 2 m. high, 13292 (♀, A, BO) (shrub 3 m. high); coastal plain forest, Momi, Vogelkop, alt. 30 m., *Kostermans* 2829 (♂, BO), Aug. 1948 (tree 2 m. high); Klamono, Sorong, sea level, *Pleyte* 664 (♀, A, BO), 666 (♂, A, BO), Aug. 1948 (shrub 2 m. high; many growing together).

15. *Macaranga caudata* Pax & K. Hoffmann in Pflanzenr. 68 (IV. 147. XIV): 30. 1919.

Shrub 2–3 m. (or tree 6–8 m.) high; young parts (branchlets, stipules, petioles, and peduncles) setulose with coarse hairs 1–2 mm. long mixed with fine hairs 0.1–0.2 mm. long; stipules 3–5.5 cm. long, ovate, long-acuminate; petioles 5–14 cm. long; leaf-blades slightly denticulate, 15–30 cm. long, 10–23 cm. broad, triangular- or orbicular-ovate, 3–5 cm. caudate-acuminate, truncate and minutely cordate at the base, inconspicuously maculo-glandular on the upper surface near the attachment of the petiole, pilose or villous-pubescent on both surfaces, particularly on the nerves and veins, and densely granulo-glandular beneath, 3–5 nerved at the base with 7 or 8 other pairs of ascending primary veins; the 4–10 cm. pedunculate and shortly branched ♂ panicle 10–20 cm. long, bracts subtending the many-flowered glomerules dilated at the base then contracted into an oblong free part puberulous outside and irregularly patelliform-glandular within; calyx 0.5 mm. long, the 3 sepals obovate, cucullate, apiculate and sparsely granulo-glandular; stamens 3 or 4 with 4-locular anthers; ♀ inflorescence 22–40 cm. long, the flowers crowded on short pedicels on the upper 3 or 4 cm. at two or three nodes and subtended by oblongish bracts, pedicels 1.5 mm. long in flower, becoming 4 mm. in fruit, the subtending bracts about 1 cm. long, coarsely pubescent on the lower midrib and bearing small patelliform glands above, calyx about 2 mm. high and dentate at the apex, splitting once or twice, circumscissile near the base; ovary 2-locular, styles 6–8 mm. long, pubescent on the lower surface and densely plumose above; capsule 1.2 cm. broad, 0.9 cm. high, and 0.8 cm. thick, covered with sparsely short-hairy soft processes 0.2–0.4 mm. long, the somewhat furrowed or rugulose seeds 5 mm. high, 6 mm. broad, and 3 mm. thick.

NETHERLANDS NEW GUINEA: occasional along small streams in flood plain primary rain forest, 4 km. SW. of Bernhard Camp, Idenburg River, alt. 850 m., *Brass* 13361 (♀, A), March 1939 (open tree 6–8 m. high; leaves sub-orbicular with long slender apex; branches, etc. irritant hairy; petioles and peduncles red).

The smallest leaf of the above-cited collection is, in the long apex and ascending venation, a very good match for a carbon rubbing of a leaf of

one of the isotypes of this species. It is to be noted, however, that the Brass material is not so pubescent (pilose rather than villous) as is described for the original; also, the stipules are obtuse and mucronate rather than long-acuminate. If I have interpreted this species correctly, it is much more closely related to *M. chrysotricha* Lauterb. & K. Schum. than to *M. urophylla* Pax & K. Hoffm., the former being characterized by stiff irritant hairs in the pubescence, few stamens, and the capsules with very short processes.

16. *Macaranga strigosa* Pax & K. Hoffmann in Pflanzenr. 68 (IV. 147. XIV): 30. 1919.

Shrub 1.5–2 m. tall with stout fulvous-setose branchlets, tardily glabrescent; stipules free, obliquely elliptic, 4–7 mm. long, appressed-villous on the outer surface; petioles 5–16 cm. long, fulvous-setose with retrorse hairs; leaf-blades bullate, orbicular-ovate, long-acuminate, 25–30 cm. long, 20–27 cm. broad, cordate at the base, remotely denticulate, glabrous above, densely granulo-glandular beneath and pilose along the nerves, densely reticulate-veined; ♂ panicle villous, 11–14 cm. long, the peduncle 7–9 cm. long; bracts subtending the branches about 3 scarlet, approximate, elliptic, 1–2.5 cm. long and about equaling the length of the branches of the inflorescence; bracts subtending the glomerules 3-lobed, the middle lobe extended and patelliform-glandular within, pilose outside; sepals 3 scarcely granulo-glandular, stamens 3 or 4 with 3- and 4-locular anthers; ♀ raceme to 15 cm. long, glabrescent, bearing small sterile bracts above the middle, 1–2-flowered at the apex; ovary 2-locular, densely covered with processes.

The type of this species, *Ledermann 10939*, was collected on Hunstein Mt., Northeast New Guinea, alt. about 1350 m. Although I have seen no material which matches this description well, I have described below some specimens from Papua as a variety. This variety differs in the somewhat larger stipules, the smaller bracts of the ♂ inflorescence, and the lack of sterile bracts along the peduncle of the ♀ inflorescence, also in foliar characters. The leaves of *M. strigosa* are very large, orbicular-ovate, bullate, and densely granulo-glandular on the lower surface, while the leaves of the variety are smaller, triangular-ovate, not bullate, and very sparsely granulo-glandular beneath.

Macaranga strigosa, var. *carrii* var. nov.

Arbor 4–6 m. alta; ramulis et petiolis setulosis et pubescentibus, setulis 1 mm. longis et pilis tenuissimis ca. 0.3 mm. longis intermixtis, setulis patentibus vel retrorsis demum caducis; stipulis 0.8–1.5 cm. longis, ovatis, acuminatis, concavis, subpersistentibus dorso adpresse setulosis; petiolo 4.5–11 cm. longo; laminis deltoideo-ovatis interdum lobulatis, 8–20 cm. longis, 6–14 cm. latis, apice longe acuminatis, acumine usque 2.5 cm. longo, basi subtruncatis vel repandis et emarginatis, dentatis vel denticulatis, novellis utrinque dense villosulis, maturis utrinque venis dense ceterum sparsim pilosis, pilis 0.3–0.5 mm. longis, basi supra eglandulosi

vel maculari-biglandulosis, subtus sparsissime granuloso-glandulosis, trinerviis, venis primariis 7–9 paribus supra basales, utrinque prominulis, subtus secundariis et rete distinctis; ♂ paniculis immaturis usque 12 cm. longis, pubescentibus et granuloso-glandulosis; pedunculo 9 cm. longo; bracteis florigeris ca. 2.5 mm. longis, basi bilobatis deinde contractis, apice in laminulam late ovatam intus patellari-glandulosam abeuntibus, ♂ floribus apicem versus pauci-granuloso-glandulosis; sepalis 2, 0.5–0.7 mm. longis; staminibus 2 vel 3, antheris 4-locularibus; ♀ inflorescentia usque 28 cm. longa, fere villosula; ♀ floribus apice conferte dispositis; bracteis 4.5–8 mm. longis, triangulari-ovatis, basi angustatis, intus patellari-glandulosis; calyce urceolato, 1.5–2 mm. longo, glabrato; ovario 2-loculari, granuloso-glanduloso et molliter echinato, stylis 2 basi connatis, ca. 9 mm. longis, papillosis vel breviter plumosis; capsula 1 cm. lata, 0.8 cm. alta, fere matura, echinis ca. 1.5 mm. longis, \pm caducis.

PAPUA: forest, Boridi, alt. about 1400 m., *Carr 13231* (♀, A, TYPE; BM), Sept. 1935 (tree about 20 ft. tall); same locality, alt. 1500 m., *Carr 13362* (♂, A, BM), Sept. 1935 (tree about 15 ft. tall); same locality, *Carr 14623* (♂, BM), Oct. 1935 (tree about 25 ft. tall); on debris of an old landslip, Mt. Tafa, alt. 2400 m., *Brass 4862* (♀, A), Aug. 1933 (small regrowth tree; branchlets, petioles and inflorescence reddish; nerves and veins reddish on the lower surface of the leaves; fruits on very long, slender, axillary peduncles; hairs irritant).

17. *Macaranga bullata* Pax & K. Hoffmann in Pflanzenr. 68 (IV. 147. XIV) : 31. 1919.

This species differs from *M. strigosa* in having leaves narrowly ("fere 1 cm.") peltate, the ♂ inflorescence openly branched and more pyramidal, the calyx granulo-glandular, and the anthers 4-locular. The type is *Ledermann 11852* collected on Schrader Mt., Northeast New Guinea.

The above is the complete description of this species given in a footnote under *M. strigosa* which also has bullate leaves. This is a meagre list of characters to use for the determination of a species in a genus as large and varied as *Macaranga*. Unless an isotype is extant somewhere which can be studied further to elaborate additional characters, I believe the species must be rejected and its name regarded as a nomen subnudum.

18. *Macaranga warburgiana* Pax & K. Hoffmann in Pflanzenr. 63 (IV. 147. VII) : 347. 1914.

Macaranga cuspidata Warburg in Bot. Jahrb. 13: 351. 1891; non Boiv. ex Baill. (1860).

Shrub with glabrous branchlets; stipules free, lanceolate, acuminate, about 1 cm. long, caducous; petiole 5–17 cm. long; leaf-blades 14–25 cm. long, 10–16 cm. broad, deltoid-ovate, abruptly acuminate, truncate at the base, bearing 4 flat glands on the glabrous upper surface near the attachment of the petiole, yellowish granulo-glandular beneath, 3-nerved with 5 or 6 pairs of primary veins above the basal ones, the secondary venation distinct but not conspicuous; ♂ inflorescence granulo-glandular,

shorter than the leaves (one in the isotype about 8.5 cm. long), bracts subtending the glomerules 1.5–2.5 mm. long, ovate or the free apex lanceolate, acuminate or acute, patelliform-glandular within; sepals 3, about 1 mm. long; stamens 2 or 3 with 3- rarely 4-locular anthers; ♀ inflorescence often longer than the leaves, on a pubescent peduncle; bracts lanceolate, granulo-glandular outside, patelliform-glandular within; calyx urceolate, truncate, glabrous, 2 mm. long; ovary pilose, 2-locular, styles papillose.

NORTHEAST NEW GUINEA: Sattelberg, *Warburg 20510* (♂, probable ISOTYPE, A), 1889.

This is a very fragmentary specimen with only a single terminal bud remaining; this bud is definitely wrapped in two stipules; further, it is to be noted that Warburg in his comment on the species stated that the stipules were not connate, hence his species could not belong to § *Dimorphantha*. I wish to emphasize this character as Pax & K. Hoffmann established a new section, § *Warburgianae*, for this species and one of the characters mentioned for both section and species is the connate stipules; however, Pax & K. Hoffmann do not indicate that they have seen Warburg's specimen. For the most part the specimen is glabrous and granulo-glandular, but here and there, if one looks carefully with the aid of a lens, are a few short, fine, setulose hairs. The ♀ inflorescence is described as having a pubescent peduncle. In a pocket on our sheet is a small tip, 1 cm. long, from a ♀ inflorescence, which is finely pubescent along the axis; it also has a few of the same type of setulose hairs as were found on the specimen. The flowers are very young. One is 2.5 mm. long with an urceolate glabrous calyx 1 mm. long, and the two styles protrude beyond the calyx about 1.5 mm. Another flower is larger with the calyx 2.5 mm. long. When the calyx is removed the styles are 4 mm. long and the ovary 1.5 mm. high. The ovary is pubescent and granulo-glandular, with four or five small spots which look like incipient processes.

Either belonging to this species or very closely allied to it are two collections from Papua. They differ as follows: plants densely setulose on the new growth, later glabrate; leaves openly cordate and dentate: ♂ inflorescence longer or shorter than the leaves; anthers all three-locular, but the same number of stamens. There is a great variation in leaf-size here: 21×18.5 cm., 10.5×6 cm., 9.5×6 cm.

PAPUA: secondary forest, Yodda River, alt. about 1350 m., *Carr 13920* (♂, A, BM), Dec. 1935; Isuarava, alt. about 1200 m., *Carr 15481* (♂, A, BM), Feb. 1936 (shrub 8 ft. tall).

19. *Macaranga bifeveata* J. J. Smith in *Nova Guin. Bot.* 8: 790, t. 139. 1912. — Pax & K. Hoffmann in *Pflanzenr.* 63 (IV. 147. VII): 377. 1914.

Shrub or tree with slender, slightly puberulous and granulo-glandular branchlets; the broadly triangular stipules 2–3 mm. long, caducous and

somewhat pubescent; petioles 4–12 cm. long, at first granulo-glandular and puberulous, later glabrate; leaf-blades triangular-ovate, 12–22 cm. long, 7–16 cm. broad (the smaller ones elliptic, 6–15 cm. long, 3–8 cm. broad), somewhat abruptly short-acuminate, at base subtruncate or broadly cuneate or sometimes openly cordate, at apex of petiole very shortly cordulate and deeply glandular-bifoveate, denticulate, at first villous-tomentose above and tomentose beneath, gradually becoming glabrous above except for the puberulous nerves, puberulous also on the nerves and veins beneath and pale yellow granulo-glandular, 3-nerved, with 5–9 pairs of primary veins above the basal ones, secondary venation below easily seen with the naked eye; the loosely branched ♂ panicle 5–17 cm. long, pubescent and granulo-glandular becoming glabrate; peduncle 3–4.5 cm. long; bracts subtending glomerules about 1.5 mm. long, spreading or recurved, semiorbicular and obtusely apiculate, cucullate with the patelliform glands of the upper surface strongly impressed; pedicels about 0.7 mm. long; calyx 3- or 4-parted, 0.7–0.9 mm. long and puberulous; stamens 4–8 with 3- and 4-locular anthers; ♀ infructescence 5–10 cm. long with 2 or 3 very short branches, bracts 5–5.5 mm. long, ovate but narrowed at base as if 1 mm. petiolate, puberulous and granulo-glandular, concave, with the patelliform glands of the upper surface strongly impressed and somewhat confluent; ♀ calyx (fide P. & H.) fusiform, denticulate and tomentulose; ovary 2-locular; the plumose styles two, 2–3.5 mm. long; fruit 2-locular, granulo-glandular, and densely covered with short puberulous processes about 2.5–3 mm. long.

NETHERLANDS NEW GUINEA: in primary forest on the Begowri River, alt. about 170 m., *Gjellerup* 209 (♂, TYPE, BO), June 1910 (tree 3 m. high).

NORTHEAST NEW GUINEA: on the way from Ramu to the coast, *Schlechter* 14113 (♂, BO), Jan. 1902; in secondary forest at Kelel, alt. about 150 m., *Schlechter* 16211 (♂, A), 16212 (one leaf, A), June 1907; margin of forest, Sattelberg, alt. about 900 m., *Clemens* 438 (♀, A), Oct. 1935 (tree 30 ft. high); Wantot (Wantot), alt. 1050–1800 m., *Clemens* 11062 (♀, A), Jan. 1940.

The bifoveate glands at the base of the leaves and the deeply impressed somewhat confluent patelliform glands of the bracts of the inflorescences are characters which render this species easy to determine. In *Clemens* 438 cited above an immature ♀ bud 3 mm. long is oblong, practically glabrous and granulo-glandular, the calyx looks as if it would be 3- or 4-lobed, the ovary is about 1 mm. long and definitely bears processes though very small ones at this stage of development.

20. *Macaranga latifolia* sp. nov.

Arbor 4–6 m. alta; ramulis puberulis vel glabris dense granuloso-glandulosis; stipulis glabris ciliolatis, triangulari-ovatis 3.5–5 mm. longis; petiolo 6–19 cm. longo, praecipue apicem versus minute puberulo; laminis latissime ovatis 13–22 cm. longis, 13.5–26 cm. latis, undulato-denticulatis, apice anguste acuminatis, acumine 1.5–3 cm. longo, basi truncatis vel

subtruncatis, ad petioli apicem minute auriculatis et maculari-glandulosis, supra puberulis vel glabris, subtus puberulis et atro-granuloso-glandulosis, trinerviis, venis primariis supra basales 5 vel 6 paribus prominulis, secundariis distinctis; paniculis ♂ usque 17 cm. longis, fere glabris et dense granuloso-glandulosis; bracteis florigeris basi concavis et fere lobatis, ovatis acutiusculis vel obtusiusculis, 1–2 mm. longis, intus patellari-glandulosis; alabastris parvis 0.7 mm. longis, sepalis 3 vel 4 apice granuloso-glandulosis, staminibus 4–7, antheris 4-locularibus; inflorescentiis ♀ usque 7 cm. longis, simplicibus flores apicem versus gerentibus; bracteis florigeris extus puberulis, ca. 4.5 mm. longis, subrhombico-spathulatis, intus patellari-pluriglandulosis, calyce subtubulato, 2–2.5 mm. longo, puberulo, ovario 2-loculari, stylis 2–3 mm. longis, plumosis; capsula sine echinis 1 cm. alta et lata, echinis 3–4.5 mm. longis, pubescentibus.

NETHERLANDS NEW GUINEA: thinned forest behind Kp. Baroe, along path, Sorong, *Pleyte* 412 (♂ & ♀, A, TYPE; BO), July 1941 (small tree about 4 m. high, 4 cm. diam., common; flowers light green to white; fruit green); Horna, *Atasrip* 41 (♀, BO), Feb. 1903; in rain forest, Nabire, *Kanehira & Hatusima* 11673 (♀, A, BO), Feb. 1940; in fringing forest, between Ayerjat and Sliber, 40 km. inland from Nabire, *Kanehira & Hatusima* 12655 (♂, A, BO), March 1940 (plant 6 m. high).

This species is unquestionably close to *M. bifoveata* J. J. Smith; in fact I have wondered whether the two are phases of a single species. They differ chiefly in the type of glands characteristic of the base of the leaves and of the floral bracts. In *M. bifoveata* the two basal glands are foveate, and those of the bracts are deeply impressed and fairly large, while in *M. latifolia* there are four small flat basal glands, and those of the bracts are also small; in the former, too, the bracts appear to be thicker or fleshier than in the latter. Smith's species is more pubescent than the one here described, and the stamens have a mixture of 4- and 3-locular anthers.

21. *Macaranga glandulifera* sp. nov.

Frutex arborescens 5–6 m. altus; ramulis novellis et petiolis dense hirtellis, pilis 1–1.5 mm. longis; stipulis triangulari-ovatis, 4–5 mm. longis, 2.5–3 mm. latis, acutiusculis, adpresse pubescentibus, rigidiusculis, subcarinatis, demum caducis; petiolo 3–12 cm. longo; laminis triangulari-ovatis, breviter acuminatis, 9–16 cm. longis, 6.5–16 cm. latis, basi truncatis et anguste cordatis, denticulatis, supra novellis pilosis, maturis costa et venis primariis tantum pilosis, saepe bullatis, basi supra maculari-pluriglandulosis, subtus granuloso-glandulosis costa et venis dense venulis sparsim hirtellis, 5–7-nerviis 3 majoribus, venis primariis supra basales 4–8 paribus prominentibus, venulis prominulis; ♂ inflorescentia non visa; ♀ paniculis hirtellis, 6–17.5 cm. longis, ramis paucis et brevibus 3 cm. vel minus; bracteis oblongis basi angustatis, 7 mm. longis, extus granuloso-glandulosis et sparsim pilosulis, intus patellari-glandulosis, glandulis interdum confluentibus; calyce 3–3.8 mm. longo, subconico, 2 vel 3 lobos rumpente deinde caduco; ovario 2-loculari, granuloso-glanduloso et echinis

mollibus tecto; stylis 2, plumosis, 6.5–7 mm. longis; capsula immatura, echinis 2–4 mm. longis, pubescentibus, \pm caducis.

NETHERLANDS NEW GUINEA: common in secondary forest, Bele River, 18 km. NE of Lake Habbema, alt. 2200 m., *Brass* 11393 (\varnothing , TYPE, A), Nov. 1938 (one of the lesser species in regrowths; large arborescent shrub 5–6 m., with pubescent, rugose, subpeltate, broad leaves).

This species is undoubtedly closely related to *M. strigosa* Pax & K. Hoffm., however, the pubescence is much softer than that which I associate with the latter species, and the pistillate inflorescences are definitely branched. Those of *M. strigosa* are described as racemose. Unfortunately no description of the \varnothing bracts or calyx of the \varnothing flower is given in the original description of that species.

22. *Macaranga densiflora* Warburg in Bot. Jahrb. 13: 350. 1891. — K. Schumann in Notizbl. Bot. Gard. Berlin 2: 128. 1898. — K. Schumann & Lauterbach, Fl. Deutsch. Schutzgeb. Südsee 396. 1900. — J. J. Smith in Nova Guin. Bot. 8: 238, 791. 1910, 1912; l.c. 12: 546. 1917. — Rechingen, Denkschr. Akad. Wiss. Wien 89: 568. 1913. — Pax & K. Hoffmann in Pflanzenr. 63 (IV. 147. VII): 372. 1914. — Kanehira & Hatusima in Bot. Mag. Tokyo 52: 411. 1938.

Mallotus acuminata sensu K. Schumann Fl. Kaiser Wilhelms Land 77. 1889; non Muell. Arg.

Macaranga involucrata var. *acalyphoides* sensu Warburg in Bot. Jahrb. 13: 352. 1891. — Senu K. Schumann & Lauterbach, Fl. Deutsch. Schutzgeb. Südsee 397. 1900. — Senu Valetton in Bull. Dept. Agric. Ind. Neerl. 10: 26. 1907; non Muell. Arg.

Macaranga acuminata Ridley in Trans. Linn. Soc. II. Bot. 9: 148. 1916.

Shrub or tree up to 8 m. high, the branchlets and petioles usually velvety-pubescent with whitish hairs 0.4–0.6 mm. long; stipules linear or linear-lanceolate, 3–6 mm. long, erect or sometimes reflexed, minutely pubescent on both sides or almost glabrous within, caducous; petioles 2–12 cm. long, the blades rhombic- or triangular- or lance-ovate, (5–) 7–18 cm. long, (2–) 4–11 cm. broad, widely cuneate, truncate or rounded then minutely cordate at the base and usually glandular-bifoveate, long-acuminate (1–3 cm.) at the apex, 3-nerved with 4–7 pairs of primary nerves obliquely ascending above the basal ones and anastomosing near the entire or denticulate margin, glabrous or sparsely pubescent above, particularly along the midrib and primaries, somewhat crisply pilose (especially on the nerves) beneath and copiously brown-glandular; σ panicle slender, 5–13 cm. long and pubescent, shortly branched and usually pedunculate; bracts subtending the glomerules crowded and pubescent on both sides, irregularly 1–5-dentate with teeth sometimes patelliform-glandular within; sepals 3, granulo-glandular at the apex; stamens 3 or 4 with 4-locular anthers; \varnothing inflorescence up to 15 cm. long with flowers and subtending bracts usually crowded at the apex; bracts

0.5–2.5 cm. long, pubescent on both sides, ovate or rhombic-ovate, acuminate and dentate with teeth patelliform-glandular within; calyx short, urceolate and pubescent; ovary 1-locular, densely glandular and bearing short pubescent processes; style 3–5 mm. long and densely papillose; capsule 4.5–5 mm. diameter, subglobose with processes 1 mm. long, tending to be deciduous.

NETHERLANDS NEW GUINEA: Horna (in the N.W. peninsula), *Atasrip* 42 (♂, BO); South McCluer, Moeteri near Babo, *Aet* 20 (♂, A, BO); Aëndoea River near Oeta, *Aet* 448 (♂, A, BO); Camp VIa, *Boden Kloss* (♂ & ♀, A, phot. of type of *M. acuminata* Ridl.); van Gelder River, *Docters van Leeuwen* 9249 (♂, BO); seashore, Toronta, *Janowsky* 577 (♂, BO); on the lower part of Arso River, *Gjellerup* 55, 55a (♂, BO); Andai, *Beccari* 8883 (P. P. 703) (♂ + ♀, F); secondary forest, Nabire, *Kanehira & Hatusima* 11431 (♂, A); common in seral growths on gravel banks in river, Hollandia, *Brass* 8900 (♂, A); Japen Island, Mamoeri, *Neth. Ind. For. Serv.* 30556 (*van Dijk* 340) (♂, A, BO); Soerei, *Aet & Idjan* 785 (♀, A, BO).

NORTHEAST NEW GUINEA: woods near Kubai, *Schlechter* 18943 (♂, A); Wau, *McAdam* 98 (♀, LAE).

BISMARCK ARCHIPELAGO: New Britain: suburb of Rabaul, *Kanehira* 3987 (♂, A), 3997 (♀, A); botanical garden, Rabaul, *Kanehira* 3954 (♂, A); Nodup, *Waterhouse* 224 (♂, A, NY); same locality, *d'Espeissis* 98 (♀, BR). Duke of York Islands: *Bradtke* 42 (♂, A, BR), 279 (♀, A; ♂ & ♀, BR).

SOLOMON ISLANDS: Bougainville: Kieta, *Kajewski* 1579 (♀, A); Karngu, Buin, *Kajewski* 2296 (♂, A).

In this species the striking characters are the crowded flower-clusters with sharply dentate bracts at the apices of the short branches of the ♂ inflorescence, the patelliform glands on the teeth of the bracts of the pistillate inflorescence rather than within the margin (as in *M. involucrata*), and the bifoveate glands at the base of the leaves. This last character is a variable one, for example: in *Docters van Leeuwen* 9249 there are two glands on some leaves, one or sometimes none on others; in *Aet* 448 the glands, if at all present, are very inconspicuous, but the ♂ inflorescence is typical of this species.

The pubescence is also variable, but there are here represented two ♀ collections which I believe deserve particular attention: *Carr* 12206 (A, BM), from Koitaki, about 450 m. alt.; and *Brass* 562 (A), Bisiatabu, about 450 m. alt. These specimens differ from the others cited above in having the leaves densely velvety-pubescent on the lower surface and sparsely pubescent above; bifoveate glands are lacking at the base of the leaves; the bracts of the inflorescence are densely pubescent on both surfaces and granular-glandular; whether they would be patelliform-glandular when more mature I cannot say; the flowers also are too immature to make any comparisons. Mansfeld in 1929 determined *Brass* 562 as *M. densiflora*. Until a definite study of the type of *M. dalechampioides* S. Moore can be made I prefer to regard these as probably a

densely pubescent form of *M. densiflora*. It is to be noted, however, that the type of Moore's species and these two collections are from the same region.

23. *Macaranga dalechampioides* S. Moore in Jour. Bot. 61: Suppl. 48. 1923.

I have been unable to examine the type specimen of this species. In his comment Moore compared it to *M. densiflora* Warb., from which it is said to differ in having more pubescent leaves and lacking glands at the base, larger and more deeply toothed inflorescence-bracts, and linear floral bracts. I have read the description carefully for distinctive characters, but the only ones mentioned which appear valuable are the linear floral bracts, the minutely pubescent ovary, and the very short style. The last two characters suggest that the flower may be very young, but of this I have no proof; as for the linear floral bracts, could it be possible that these are the stipules of the closely crowded bracts at the apex of the inflorescence? In other words, this type needs to be studied carefully with more and comparative material before its identity can be established.

24. *Macaranga urophylla* Pax & K. Hoffmann in Pflanzenr. 63 (IV. 147. VII): 377. 1914.

Tree to 15 m. high with ferrugineous subvillous branchlets; stipules lanceolate, 6–10 mm. long, acuminate, densely pubescent, and caducous; petioles 6–8 cm. long, pubescent; leaf-blades triangular-ovate and slightly denticulate, 12–18 cm. long, 7–13 cm. broad, caudate-acuminate at the apex, at the base 3-nerved and broadly truncate, also slightly cordate, with 2–4 flat glands on the upper surface near attachment of the petiole, reticulate-veined and densely granulo-glandular beneath, the veins villous; the pubescent and densely flowered ♂ panicle 12–17 cm. long with short remote branches, the peduncle 5–6 cm. long; all bracts small (2–3 mm. long), with the basal part suborbicular then contracted, the apex abruptly acuminate, pubescent on both sides, granulo-glandular beneath and patelliform-glandular above; ♂ flowers pubescent and granulo-glandular near the apex, 1.5 mm. long with 3 obovate acute sepals and 7–10 stamens with 4-locular (and sometimes 3-locular) anthers; ♀ inflorescence slender, simple (?), few-flowered, on pubescent peduncle 9–10 cm. long; bracts subfoliaceous and petiolate, lanceolate or linear-lanceolate, 1.5 cm. long, entire, within, along the margin, patelliform-glandular; pedicels 1–2 mm. long; ♀ flower with cupular dentate calyx pubescent and sparsely granulo-glandular, at length splitting spathe-like; the ovary 1-locular and densely covered with short unequal processes, the plumose style 2 mm. long; capsule unknown.

The type of this species was collected at Namatanai, New Ireland (Peckel 669). The description given above is a translation of the original and not drawn from the material here cited. None of these specimens agree wholly with the original description, nor do they agree too well with

each other, but since there is not enough material at hand to estimate the amount of variation within the species, it seems best to place them here, indicating points of difference.

SOLOMON ISLANDS: Bougainville: rain forest, Kupei Gold Fields, alt. 950 m., *Kajewski 1648* (♀, A), April 1930 (small to medium-sized tree up to 15 m. high); Kieta, sea level, *Kajewski 1608* (♂, A), March 1930 (small tree up to 15 m. high); Kugu-maru, Buin, alt. 150 m., *Kajewski 1788* (♂, A), March 1930; east side of Kamo Mountain, alt. about 100 m., *Robinson & Volk NGF 804* (♀, A, BR, LAE), Jan. 1945. Malaita: Quoi-mon-apu, sea level, *Kajewski 2314* (♂, A), Dec. 1930 (very small tree up to 10 m. high, the lower surface of the leaves is silky to touch and the natives use them to dry themselves after swimming). San Cristoval: rain-forest regrowths, lowlands, Waimamura, *Brass 2566* (♀, A), Aug. 1932 (common shapely small tree 5 m. tall, exuding a thick brown gum when cut; young parts velvety with shining gray pubescence; petioles and underside of main nerves purple).

Kajewski 1648 is perhaps most like the description of *M. urophylla*, with the apices of the leaves very slender and ca. 2 cm. long. The ♀ bracts are very slender, 1.5 cm. long and scarcely more than 2 mm. wide at the base. The styles are about 9 mm. long, yet the flowers have not yet lost the calyx; this style-length is much greater than that of the original. In *Kajewski 2314* the pubescence might be called subvillous, — the hairs are a little short of villous; the pubescence somewhat approaches that of the original. It is to be noted, however, that the leaves tend to be three-lobed, with the apex of the middle lobe about 4 cm. caudate; stamens five to seven. *Kajewski 1608* has a short compact pubescence (almost tomentose), but the leaves show the same tendency toward lobing as in the last specimen mentioned, only in a much less degree. *Kajewski 1788* and *Robinson & Volk 804* look like perfectly matched ♂ and ♀ plants. The glands at the base of the leaves are the same type and placed the same; the ♀ bracts are lanceolate, 1.5 cm. long and 3–5 mm. broad at the base, gradually tapering to the apex, the stipules arc ovate-lanceolate or oblong. In *Brass 2566* the ♀ bracts are up to 3 cm. long and 8 mm. broad.

In addition to these already mentioned there are two more collections which I add here hesitantly. The stipules in *Brass 3243* (♀, A) are almost glabrous and membranaceous and the young leaves have a floccose tomentum; in *Kajewski 2557* (♂, A) the stipules are pubescent, but the upper surface of the young leaves is floccose. Both are regrowth trees. *Brass 3243* was collected at Kakatio, Ysabel, alt. 900 m., and *Kajewski 2557* came from Ulolo, Tutuve Mt., Guadalcanal, alt. 1200 m.

Although Pax & K. Hoffmann relate the species to *M. schleinitziana* K. Schum., I believe the material here cited is closer to *M. involucrata* (Roxb.) Baillon.

25. *Macaranga involucrata* (Roxb.) Baillon Etud. Gén. Euph. 432. 1852. — Warburg, Bot. Jahrb. 13: 352. 1891. — Pax & K. Hoffmann in Pflanzenr. 63 (IV. 147. VII): 374. 1914.

Urtica involucrata Roxburgh, Hort. Beng. 67. 1814; Fl. Ind. ed. 2, 3: 592. 1832.

Mecostylis acalyphoides Kurz ex Teysmann & Binnendijk in Tijdschr. Nederl. Ind. 27: 44. 1864.

Macaranga amboinensis Mueller Arg. in DC. Prodr. 15 (2): 1002. 1866.

Tanarius involucratus O. Ktze. Rev. Gen. 2: 620. 1891.

Shrub or tree with branchlets, petioles, stipules, and inflorescences spreading-pubescent or puberulous; stipules linear, 5–10 mm. long; petioles 3–7 cm. long; the ovate or triangular-ovate leaf-blades 8–17.5 cm. long, 5.5–15 cm. broad, 1–3 cm. acuminate, epeltate and very slightly cordate with the base rounded or truncate or sometimes very narrowly (2–4 mm.) peltate, densely pilose when young, later (except for the pilose veins) glabrous above and sparsely pilose beneath with veins more densely so, above maculo-glandular, beneath densely granulo-glandular, 3–5-nerved with 5 or 6 pairs above the basal ones; ♂ panicle 5–10 cm. long with spreading branches and usually granulo-glandular; the small (1–1.5 mm.) bracts subtending the glomerules triangular-ovate, patelliform-glandular within; flower buds just before anthesis 0.5–0.7 mm. long; sepals 3, stamens 6–10 with 4-locular anthers; ♀ inflorescence 5–15 cm. long, mostly with ♀ flowers clustered at the apices, the bracts foliaceous and bistipulate, up to 4 cm. long, ovate, dentate, and mostly long-acuminate, within the margin patelliform-glandular, usually pubescent or puberulous on both sides and outside granulo-glandular; pedicels 1.5–3 mm. long; calyx tubular-conic, quickly circumscissile or splitting and falling; ovary 1–(sometimes 2–) locular, the plumose style 7–10 mm. long and pubescent on the dorsal surface; capsule globose, 5–6 mm. diameter, granulo-glandular and bearing hairy processes 1.5–2.5 mm. long.

NETHERLANDS NEW GUINEA: on edge of rain forest, Nabire, alt. 20 m., *Kanehira & Hatusima* 11669 (♀, A), Feb. 1940. Biak Island, on coral cliff top along coast near Soredo, alt. about 25 m., *Britton* 85 (♂ & ♀, A), May 1945 (small tree 15–20 ft. high, common).

The second specimen is atypical in having appressed pubescence, but I can find no other difference in the material at hand. The species is a native of the Moluccas; there are at hand specimens from Amboina, Ternate, Ceram, and the Key Islands. I am doubtful whether Pax & K. Hoffmann were right in raising Warburg's var. *keyensis* to specific rank, as both taxa occur on the islands.

Macaranga involucrata var. *mallotoides* (F. Muell.) comb. nov.

Macaranga mallotoides F. Mueller, Fragm. 4: 139. 1864. — Pax & K. Hoffmann in Pflanzenr. 63 (IV. 147. VII): 376. 1914.

Macaranga involucrata Baillon in Benth. & F. Muell., Fl. Austral. 6: 146. 1873. — F. M. Bailey, Queensl. Fl. 5: 1451. 1902.

This variety differs from the typical species in the densely flowered branches of the ♂ inflorescence; bracts subtending the crowded glomerules of ♂ flowers are recurved, ovate-suborbicular, and denticulate, granulo-

glandular and somewhat puberulent on both sides, and on the upper surface at times patelliform-glandular; the bracts of the ♀ inflorescence are denticulate and usually acute rather than acuminate, and the style is 5–8 mm. long.

NETHERLANDS NEW GUINEA: forest near camp, Gelieb, *Branderhorst* 210 (♂, BO), Nov. 1907.

PAPUA: gregarious in contact zone of rain and savannah forests, Gaima, Lower Fly River (east bank), *Brass* 8342 (♂, A), 8342A (♀, A), Nov. 1936 (tree 3 m. high); abundant in rain forest and invading disturbed savannah forests, Tarara, Wassi Kussa River, *Brass* 8694 (♂, A), 8694A (♀, A), Jan. 1937 (shrub or small tree 3 or 4 m. high).

This variety is very close to var. *keyensis*, the latter being more nearly glabrous with bracts undulate or only barely denticulate.

26. *Macaranga schleinitziana* K. Schumann in Bot. Jahrb. 9: 207. 1887; in K. Schumann & Hollrung, Fl. Kaiser Wilhelms Land 79. 1889. — Warburg in Bot. Jahrb. 13: 351. 1891. — K. Schumann & Lauterbach, Fl. Deutsch. Schutzgeb. Südsee 397. 1900; Nachtr. 297. 1905. — Pax & K. Hoffmann in Pflanzenr. 63 (IV. 147. VII): 373. 1914.

Macaranga Schleinitziana var. *β lobulata* Pax & K. Hoffmann, l.c.

Shrub or small tree with slender, densely velvety-pubescent branchlets, stipules, petioles, and inflorescence-axes; the narrowly linear stipules 4–6 mm. long, caducous; petioles 2.5–12 cm. long; leaf-blades (6.5–) 11–21 cm. long, (3–) 7–20 cm. broad, triangular-ovate or rhombic-ovate or somewhat 3-lobed, acuminate (apex 0.5–3 cm. long), broadly truncate or rounded and slightly cordate at the base, and above near the attachment of the petiole bearing 2–4 flat glands, 3-nerved with 5–8 pairs of primary veins above the basal ones, on the upper surface sparsely pubescent, beneath shortly villous and dark granulo-glandular, reticulations fairly distinct on the lower surface of the older leaves; ♂ panicle 4–15 cm. long with short but densely flowered branchlets; all bracts small, 1–3 mm. long, ovate or oblong, acute, often slightly lobed on either side at the base, within patelliform-glandular or sometimes eglandular, usually pubescent on both sides and recurved; pedicels about 1 mm. long; sepals 3, concave, about 0.7 mm. long, pubescent and granulo-glandular, stamens 7–12 with 4-locular anthers; ♀ inflorescence 6–25 cm. long (including the peduncle 5–15 cm. long), at times with very short branches (up to 2 cm. long); bracts foliaceous, 1–3 cm. long and ovate or rhombic-ovate, denticulate and acuminate, pubescent on both sides, within near the margin, especially toward the base, patelliform-glandular; pedicels short becoming up to 8 mm. long in fruit; calyx of the ♀ flowers cupular, truncate, 1–1.5 mm. long, densely pubescent and granulo-glandular; ovary 1-locular with pubescent processes overtopping the calyx, the plumose style 4–6 mm. long, pubescent on the back; capsule globose and granulo-

glandular, 5 mm. diameter, the processes tending to be caducous, especially toward the base (those remaining on the fruit scarcely 1 mm. long).

NETHERLANDS NEW GUINEA: Sigar on McCluer Bay, *Warburg* 20697 (♂ & ♀, A); Rori-esi near Babo, on McCluer Bay, *Aet* 161 (♀, A, BO).

NORTHEAST NEW GUINEA: Kelel, alt. 150 m., *Schlechter* 16146 (♀, A), June 1907; Saki, alt. 250 m., *Schlechter* 18289 (♂, A), Sept. 1908; vicinity of Kajabit Mission, alt. 240–600 m., *Clemens* 40681 (♂, MICH), Aug. 1939; Boana, alt. 750–1300 m., *Clemens* 41482 (♂, A), May–Nov. 1940; Finschhafen, *Warburg* 20507 (♀, A), March, April 1889; region of Bumi, *Weinland* 125 (♀, BR), 1889–91; on rain-forest margin, Yalu, alt. about 15 m., *White, Dadswell, & Smith* NGF 1621 (♀, A, BR, LAE), July 1944; Lae, *White, Dadswell & Smith* NGF 1676 (♀, A, BR, LAE); Bulolo, *Fryar* NGF 3957 (♀, A), Feb. 1950; Bulolo, *McIntosh* NGF 3573A (♀, A, LAE), Jan. 1950; on beach, Salamaua, *Kanehira* 4018 (♀, A), Feb. 1937; Constantinhafen, *Schlechter* 14225 (♂, BO).

27. *Macaranga similis* Pax & K. Hoffmann in *Pflanzenr.* 68 (IV. 147. XIV): 29. 1919.

Macaranga Brassii Mansfeld in *Jour. Arnold Arb.* 10: 78, 232. 1929.

Small or middle-sized tree 4–7 m. high with young branchlets, stipules, petioles, leaf-blades, and inflorescences velutinous; stipules 1–1.7 cm. long, 0.4–0.6 cm. broad, lanceolate or lance-ovate or slightly obovate-oblong and carinate, not readily caducous; petioles 5–11.5 cm. long; leaf-blades triangular-ovate (sometimes somewhat 3-lobed or suborbicular-ovate), 8–21 cm. long, 6.5–19 cm. broad, subabruptly short-acuminate, cordate at the base or rarely narrowly (7 mm.) peltate, bearing 2–6 flat glands (occasionally none) on the upper surface near the attachment of the petiole, densely dark granulo-glandular beneath, 3-nerved or in peltate leaves shortly palmate-nerved, with 6–9 pairs of primary veins above the basal ones; ♂ panicle 4–18 cm. long, the peduncle 1.5–5 cm. long; bracts subtending glomerules small (1.5–4 mm. long), somewhat 2-lobed at the base then contracted and just above slightly broadened into a lanceolate or ovate apex, sparsely granulo-glandular and pubescent beneath, on the upper surface pubescent near the margin and above patelliform-glandular; sepals 3, concave and pubescent; stamens 6–12 with 4-locular anthers; ♀ inflorescence 10–22 (–35, fide Mansfeld) cm. long with flowers and fruits on the upper 2–9 cm., bracts and flowers crowded at 1–4 nodes; bracts triangular-ovate, 0.6–2.5 cm. long, 0.3–2 cm. broad, subfoliaceous, velutinous and granulo-glandular beneath, pilose on the upper surface along the veins and on the few or many patelliform glands well within the denticulate margin; pedicel 1.5 mm. long at time of flowering, becoming 6 mm. in fruit; calyx pubescent, cupular and truncate, about 1.2–1.5 cm. long, splitting and falling; ovary 1-locular, the plumose style 6–9 mm. long, pubescent on the lower surface; fruit subglobose, about 5 mm. diameter, granulo-glandular and bearing pubescent processes about 1–2.5 mm. long; seed dark-colored, rugulose, 3.5 mm. long, 3 mm. broad.

PAPUA: Laloki River, alt. about 260 m., *Brass* 536 (♂ & ♀, A), Oct. 1935; on or about rocks on *Eucalyptus* savannahs, also rain-forest fringes; Rona, La-

Ioki River, *Brass* 3633 (♂, A, BO, NY), March 1933 (common small shapely tree 4-5 m. high); Mafulu, *White* 566 (♂ & ♀, BR), July, Aug. 1918; open country, Veiya, *Carr* 11707 (♂, A, BM), Mar. 1935 (tree 30 ft. tall); secondary forest, Kanosia, alt. about 60 m., *Carr* 11060 (♀, A, BM, NY), 11063 (♂, A, BM, NY), Feb. 1935; secondary forest, Boridi, alt. about 1140 m., *Carr* 14662 (♀, A, BM), 14687 (♂, BM), Oct. 1935; Buna area, *Lane-Poole* 166A (♂, BR), July 1922; Domara River, *Brass* 1590 (♀, ISOTYPE of *M. Brassii*, A), May 1926 (common weed tree); Fife Bay, *Turner* 81 (♀, A, BR), Oct. 1930.

In my work on this and related species I had no doubt as to the identity of *M. Brassii*, of which we have an isotype, but I was at a loss to interpret *M. similis* P. & H. because of the description of the pubescence of the leaves, given as a mixture of stellate and simple hairs. I have seen only one species of *Macaranga* with truly stellate hairs, *M. noblei* Elmer of the Philippines. In this species only the ♀ plant is known, although I must admit that, even though the fruit looks like a *Macaranga*, one should see the ♂ flowers to be sure of the genus. In *M. Brassii* the hairs at times appear to be clustered in little bunches or fascicles along the veins. Apart from the description of the pubescence, the rest of the characters fit *M. Brassii*, hence the reduction of the latter.

28. *Macaranga chrysotricha* Lauterbach & K. Schumann in K. Schum. & Lauterb. Fl. Deutsch. Schutzgeb. Südsee 399. 1900. — Pax & K. Hoffmann in Pflanzenr. 63 (IV. 147. VII): 378. 1914.

Small tree; branchlets, petioles, and peduncles closely covered with fine hairs 0.1-0.2 mm. long, also setulose with stiffish golden hairs 1-2 mm. long, tardily glabrescent; stipules 2-2.5 cm. long, ovate-lanceolate and acuminate, appressed setulose and free (in specimens seen); petioles 5-17 cm. long, the slightly denticulate leaf-blades 15-30 cm. long, 16-22 cm. broad, orbicular-ovate, entire or 3-lobed and acuminate, openly cordate at the base and inconspicuously 2-4-maculo-glandular above, pilose on both surfaces (young leaves densely hairy), finely bullate above and densely reticulate beneath, 3-7-nerved at the base with 4-6 additional pairs of openly ascending primary veins; the 7-13 cm. pedunculate ♂ inflorescence paniculate with pubescent and sparsely granulo-glandular branches; bracts subtending the glomerules dilated at the base then contracted into an ovate lobe patelliform-glandular within; sepals 2, triangular-ovate and granulo-glandular outside at the apex, stamens 2 or 3 with 4-locular anthers; the long-pedunculate ♀ inflorescence 21-30 cm. long and bearing flowers only at the apex; bracts subtending the flowers 2-3 mm. long, stipitate and obtusely ovate or subrhombic, pubescent below and patelliform-glandular above; calyx 1-2 mm. long splitting into 3 or 4 or sometimes 5 parts; ovary 1-locular, the style 2 or 3 mm. long, long-plumose; fruit small, 4 or 5 mm. diameter, granulo-glandular and covered with soft pubescent processes 0.4-0.6 mm. long.

NORTHEAST NEW GUINEA: Sattelberg, *Nyman* 495 (♂, G), June 1899; Kani Mt., alt. about 1000 m., *Schlechter* 17287 (♂, A), Feb. 1908 (small tree).

28A. *Macaranga chrysotricha* var. *glaucescens* Mansfeld in Jour. Arnold Arb. 10: 78, 233. 1929.

Common small tree of forest regrowths, differing from *M. chrysotricha* in having leaves not or scarcely bullate, the branchlets, stipules, petioles, and often the peduncles glaucous (rather than finely pubescent as in the species) and setulose with coarse hairs about 1.5 mm. long.

PAPUA: rain forest, Bisiatabu, alt. about 450 m., *Brass* 589 (♂, A, ISOTYPE), Aug. 1925 (slender tree about 6 m. tall; trunk smooth, green; branchlets glaucous, covered with small brownish prickles; stipules large, deciduous; leaf-scars prominent); Mafulu, *White* 440 (♀, BR), July–Aug. 1918; in forest regrowths, Bella Vista, alt. 1450 m., *Brass* 5464 (♂, A, BO, NY), 5473 (♀, A, BO), Nov. 1933 (small tree 3 or 4 m.; peduncles, petioles, stipules, and branchlets glaucous; inflorescence on long erect peduncle; capsules small).

29. *Macaranga punctata* K. Schumann in Fl. Kais. Wilhelms Land 80. 1889. — K. Schumann & Lauterbach, Fl. Deutsch. Schutzgeb. Südsee 397. 1900. — Pax & K. Hoffmann in Pflanzenr. 63 (IV. 147. VII): 362. 1914.

? *Macaranga isadenia* Pax & K. Hoffmann in Pflanzenr. 63 (IV. 147. VII): 377. 1914.

Macaranga ovalifolia Pax & K. Hoffmann in Pflanzenr. 68 (IV. 147. XIV): 29. 1919.

Macaranga pseudopeltata Pax & K. Hoffmann in Pflanzenr. 68 (IV. 147. XIV): 29. 1919.

Macaranga maluensis Pax & K. Hoffmann in Pflanzenr. 85 (IV. 147. XVII): 185. 1924.

Tree 4–12 m. tall with the tips of the branchlets somewhat crisply ferrugineous-tomentose, quickly glabrate; stipules linear-lanceolate or linear-oblong, 4–7 mm. long, stiffish, quickly caducous; petiole 2–8 cm. long; leaf-blades variable in form and size, oblong-ovate, elliptic-ovate or triangular-ovate, 11×4.5 cm., 13.5×4 cm., 19×9 cm., 22×10 cm., 22×14 cm., 26×15 cm., entire, acuminate, the acumen 0.5–2 (–4) cm. long, rounded at the base, very narrowly cordate or narrowly (4–8 mm.) peltate, glabrous above and marked at the base, close to the attachment of the petiole, with 4–8 small flat glands, puberulous beneath or sometimes pilose on the veins and rather densely dark granulo-glandular, 3-nerved with 8–11 pairs of primary veins above the basal ones, prominulous on the lower surface, the secondary venation easily seen; ♂ panicle 9–15 (–25) cm. long including the peduncle 3–12 cm. long, ferrugineous-tomentulose; bracts supporting the glomerules 1.5–2.5 mm. long, somewhat dilated at the base, obtusely ovate above, usually reflexed, beneath granulo-glandular, and on the upper surface patelliform-glandular; ♂ flowers small, usually with a few dark glands near the apex; sepals 3 or 4, about 0.7 mm. long; stamens (3–) 5–10 with 4-locular anthers; ♀ inflorescence 7–16 cm. long, ferrugineous-tomentulose, simple or with very short (0.5–1 cm.) branches at intervals along the axis; bracts subtending the branches lanceolate, about 1 cm. long, patelliform-glandular within;

bracts subtending the flowers 3 mm. long, 2.5 mm. broad, obtusely ovate or suborbicular, narrowed at the base into a very short stalk, patelliform-glandular on the upper surface; calyx pubescent, cupulate, 1.5 mm. high, splitting on one side and falling later; style 4 mm. long, plumose; ovary 1-locular, granulo-glandular, with slender puberulous processes, the latter in partly grown fruit about 2 mm. long.

NETHERLANDS NEW GUINEA: Humboldt Bay, *Beccari 8882* (♀, F), 8882A (♂, F); west of Hollandia, north of Simboro Strait of Sentani Lake, alt. about 180 m., *Sigafoos 99* (♂, A), Mar. 1945; Mt. Cycloop, on the path from the foot to Netar close to the margin of the forest, alt. about 400 m., *Meyer-Drees 72* (*Neth. Ind. For. Serv. bb.25038*) (♀, A, BO), June 1938; hills north of Hollandia, alt. about 50 m., *Meyer-Drees 157* (*Neth. Ind. For. Serv. bb.25054*) (♂, A, BO). Misool: Blowpo Mt., alt. about 100 m., *Pleyte 937* (♂, A, BO), Sept. 1948 (shrub 5 m. high); near Fakal, *Pleyte 1101* (♂, A, BO), Oct. 1948 (shrub 5 m. high).

PAPUA: common in poor type rain forest on ridges, Lake Daviumbu, Middle Fly River, *Brass 7570* (♂, A), 7570A (♀, A), Aug. 1936 (plentiful slender tree 6-8 m. high, apparently not subseral; leaves ovate-oblong, cordate or peltate on same tree); rain forest substage, Kubuna, alt. 100 m., *Brass 5603* (♂, A, BO), Nov. 1933 (small tree; leaves black punctate beneath).

NORTHEAST NEW GUINEA: Augusta River, *Hollrung 825* (♂, BO, isotype), 1887; in foothill forest, Yellow River hills, Sepik District, *Womersley NGF 3932* (♀, A), Oct. 1949 (tree 60 ft. over all, diameter breast high 10"; leaves very light green, almost glaucous below; bark smooth, gray-brown on the back, inner bark straw-brown and rather fibrous; wood white).

It was my good fortune to find an isotype of this species in the loan from the Bogor Herbarium. In this specimen the bracts subtending the ♂ glomerules are densely patelliform-glandular on the upper surface. This feature is not mentioned in the original description, and it apparently was unobserved by Pax & K. Hoffmann, who placed the species in § *Echinocarpace* rather than in § *Mecostylis* to which it belongs. A carbon rubbing of a leaf of *Ledermann 12258*, the type of *M. pseudopeltata* Pax & K. Hoffm., is a perfect match for a leaf of the isotype of *M. punctata* K. Schum. It is a little more difficult to estimate *M. maluensis* Pax & K. Hoffm. (*M. ovalifolia* Pax. & K. Hoffm., not Ridley); in a carbon rubbing of a leaf of the latter species the primary veins are slightly further apart, but I believe *M. maluensis* to be merely the ♀ form of *M. punctata*. With a good deal of hesitancy I have added *M. isadenia* to the synonymy, indicating my indecision with a query. I have a carbon rubbing of a leaf of this species also; the rubbing is a good match for the form of the leaves of *Brass 7570A*, and *Womersley NGF 3932*, but neither is so glandular as *M. isadenia* (according to the description). The leaves of these two collections are triangular-ovate and larger than those of the other specimens above cited. However, in the collections cited there are transitional forms so that I have been at a loss to draw a dividing line between the two extremes as to form and size of leaves. Further, *Womers-*

ley NGF 3932 is not the terminal part of a branchlet, hence might have larger leaves than the part with a growing tip. The ♂ collection, *Brass* 7570, has leaves somewhat larger than those of the isotype of *M. punctata* but the pubescence, the shape of the leaves, and the bracts subtending the glomerules are all very much like this species, and though the stamens tend to be fewer (3–5), I have no hesitancy in placing the collection in *M. punctata*. The material of *Brass* 5603 shows another variation, the leaves are more pubescent than those of the other specimens cited above, further they are not maculo-glandular close to the attachment of the petiole, however, the characters of the inflorescence are those of this species.

29A. *Macaranga punctata* var. *whitei* var. nov.

A forma typica differt partibus juvenilibus granuloso-glandulosis et puberulis, foliis novellis tantum \pm tomentosis; laminis plerumque angustioribus, 9.5–23 cm. longis, 3.5–8 cm. latis, subtus costa et venis minute puberulis vel interdum pilosis vel omnino glabris, venis primariis 5–7 paribus; ♂ paniculis puberulis, 10–18 cm. longis; bracteis basi dilatatis deinde subito contractis, demum in laminulam lanceolatam intus patellari-glandulosam productis, plerumque patentibus; staminibus 2–4, antheris 4-locularibus; ♀ inflorescentia 12–22 cm. longa, plerumque simplici, circa medium interdum bracteis sterilibus parvis instructa, apice ♀ floribus paucis conferta; stylo 5–7 mm. longo.

PAPUA: rain forest, Dieni, Ononge Road, alt. 500 m., *Brass* 3976 (♀, A, BO), 3977 (♂, A, TYPE; BO), May 1933 (common small tree 5–6 m. high; leaf-nerves pale brown beneath); Bisiatabu, *White* 289 (♀, BR), July/Aug. 1918; Mekeo area, Central District, *White* 799 (♀, BR), July/Aug. 1918; Koitaki, alt. about 450 m., *Carr* 11990 (♂, A, BM), 12070 (♀, A, BM), Apr. 1935 (tree about 15 ft. tall).

30. *Macaranga advena* Pax & K. Hoffmann in Pflanzenr. 68 (IV. 147. XIV): 31. 1919.

Small tree 5–6 m. high; new branchlets with young parts ferruginèous-tomentose, at length glabrate; stipules ovate, acuminate, almost 8 mm. long, glabrous and deciduous; petiole slender, 2–3 cm. long, pilose; leaf blades entire, 9–20 cm. long, 1.5–4 cm. broad, ovate-lanceolate with a very narrow linear apex up to 4 cm. long, at the base rounded and very narrowly cordate with the lobes overlapping, glabrous above and marked at the base with several flat glands, sparsely pilose below, reticulate and densely granulo-glandular, feather-veined with 6–8 pairs of primary veins; ♂ inflorescence unknown; ♀ raceme 5–10 cm. long, bearing sterile bracts below and about 4 flowers crowded at the apex of the slender tomentulose rachis; bracts rhombic-ovate and narrowed at the base, 6 mm. long, patelliform-glandular on the upper surface within the margin, pilose beneath and densely granulo-glandular; calyx cupular, denticulate and granulo-glandular; ovary 1-locular and bearing processes, the style lateral, densely plumose, 2 or 3 cm. long.

The type, *Ledermann 12490*, was collected in mountain forest at 1400–1500 m. in Northeast New Guinea. I have not seen it, and we do not have any material at hand which appears to fit the description. The style is two or three centimeters long, as given in the original description. Such a very long style is unusual in *Macaranga*, and it is likely that the authors intended the measurement to be in millimeters.

31. *Macaranga angustifolia* Lauterbach & K. Schumann in Fl. Deutsch. Schutzgeb. Südsee 398. 1900; Nachtr. 297. 1905. — Pax & K. Hoffmann in Pflanzenr. 63 (IV, 147. VII): 379. 1914. — C. T. White in Proc. Roy. Soc. Queensl. 34: 39. 1922.

Glabrous tree to 20 m. high with pendulous branches; the linear-subulate stipules 4–6 mm. long falling very quickly; petioles 2–5 cm. long; the narrowly lanceolate leaf-blades 6.5–24 cm. long, 2.5–5.5 cm. broad, acuminate, more or less narrowed towards the base, then minutely cordate, above nearly oblong, maculo-biglandular, beneath densely appressed-granulo-glandular, pinnately veined with 8–10 pairs of distinct primary veins obliquely ascending and arcuate near the margin, the secondary venation easily seen on either side; panicles of both sexes puberulous or almost glabrous and granulo-glandular, 4–9 (–13 in ♀) cm. long; the ovate bracts at the base of branchlets in ♂ and at the base of fascicles of flowers in ♀ 5–7 mm. long with entire or dentate apex, reflexed and bearing on the upper surface near the base 2 (rarely 3) large (1.3–1.8 mm. long) patelliform glands; ♂ flowers in glomerules; ♀ flowers fascicled on pedicels 1.5 mm. in the young flowers to 5 mm. long in the fruit; ♂ flowers just before expanding 1 mm. long with 2 or 3 granulo-glandular sepals and 11–15 stamens with 4-locular anthers; ♀ flower according to the original description with very short truncate cupular calyx (in specimens cited below with a caducous 3-lobed calyx, the lobes about 1 mm. long and the lower part 0.5 mm.), ovary 1 (rarely 2) -locular, densely granulo-glandular and glabrous with 2 processes, the plumose style about 2 mm. long, lateral and deciduous; capsule subglobose 2.5–3 mm. diameter with processes about 1 mm. long; seed rugulose, brown.

NORTHEAST NEW GUINEA: on the way from Ramu to the coast, *Schlechter 14173* (♂, BO), February 1902; on Minjem below Albu, alt. about 100 m., *Schlechter 16224* (♂, A), July 1907; above the mission near Sattelburg, on a mountain trail at about 900 m. alt., *Clemens 8063* (♀, A), March 1938; forest hills, Quembung, alt. about 750 m., *Clemens 3193* (♀, A), June 1936; vicinity of Wantoat, alt. about 1200–1500 m., *Clemens 11329A* (♀, A), March 1940.

PAPUA: Central District, Deva Deva, *White 633* (♀, BR).

It should be pointed out here that the leaves of the pistillate material cited above are not as long as those of the staminate material, and that the base is not quite as narrow. I am satisfied, however, that the specimens all belong to this species.

32. *Macaranga astrolabica* Pax & K. Hoffmann in Pflanzenr. 63 (IV. 147. VII): 343. 1914.

Type-specimen glabrous except for the puberulous upper branchlets and bracts of the ♂ inflorescence; branchlets slender; stipules narrowly triangular, 2 mm. long, soon falling; petiole 2–4 cm. long; leaf-blades subcoriaceous and entire or repand, lanceolate 8–17 cm. long, 3.5–5.5 cm. broad, much smaller at the apices of the branchlets, acutely long-acuminate, rounded at the base, narrowly cordate at the attachment of the petiole and bearing 2–6 spot-like glands on the upper surface, shortly 3-nerved with 6 or 7 pairs of primary veins, granulo-glandular and net-veined beneath; ♂ panicle 4–8 cm. long, narrow and slender with few branches, fasciculate, borne on a peduncle, the rachis glabrous below, above with the branches puberulous; bracts subtending the branches ovate-triangular, acute, puberulous, glandular, the bracts subtending the glomerules 2–3 mm. long, spreading, lanceolate, narrowed at the base, acute, entire or repandly lobulate, glabrous or almost glabrous, patelliform-glandular within; ♂ flower 1 mm. broad, the sepals 2, ovate, concave, granulo-glandular outside at the apex; stamens 2 with 4-locular anthers; ♀ flowers and fruit unknown.

The type, *Brown 165*, was collected at Astrolabe Bay. I have seen nothing to match this description.

33. *Macaranga sterrophylla* sp. nov.

Arbor usque 12 m. alta; ramulis, petiolis, foliis novellis inflorescentiis, et dorso medio stipulorum brunnescenti-sublanato-tomentosis, tarde glabratis; stipulis anguste obovatis, acutiusculis, 0.8–1.3 cm. longis, subscariosis, marginem superiorem versus glabris; petiolo 1–3 cm. longo; laminis valde coriaceis, ovatis, acutis vel obtuse acuminatis, 3–5.5 (–9.5) cm. longis, 1.9–3.5 (–5) cm. latis, integris, maturis fere glabris, subtus dense granuloso-glandulosus, trinerviis, venis primariis 4 vel 5 paribus supra basales, subtus prominentibus, rete subtus prominulo; ♂ inflorescentia immatura vix 4 cm. longa, vix ramosa; bracteis ramigeris (?) approximatis, lanceolatis, ca. 8.5 mm. longis, basi petioliformibus; bracteis florigeris 1.5–3.5 mm. longis, ovatis vel ovalibus obtusis, intus patellari-glandulosus; ♂ alabastris tantum visis; staminibus 3, antheris 4-locularibus; ♀ inflorescentiis usque 6 cm. longis; floribus racemosis; bracteis obovatis, 4 mm. longis, basin versus angustatis, intus patellari-glandulosus; calyce 1–1.5 mm. alto, glabro et sparsim granuloso-glanduloso, demum rumpente; ovario 1-loculari, ca. 3.5 mm. longo, laxo tomentuloso et granuloso-glanduloso, interdum pauci-tuberculato; stylo obliquo, subterminali, sublaevi, vix 1 mm. longo; capsula ca. 8 mm. longa et 6 mm. lata; semine ca. 5 mm. diametro, subgloboso.

PAPUA: fairly common in forest, Murray Pass, Wharton Range, alt. 2840 m., *Brass 4560* (♀, A, TYPE; BO), July 1933 (erect branched tree up to 12 m. high, with dense crown of leaves; leaves very stiff, glossy above, paler below, nerves underneath prominent and whitish; indumentum pale brown; fruit immature);

on an old landslide, main range NW of The Gap, alt. about 2400 m., *Carr 15240* (♂, BM), Jan. 1936 (shrub about 7 ft. tall).

This species of *Macaranga* has stiffer leaves than any of the others which I have examined. The net-venation is prominent on the lower surface and very slightly raised above; none of the other species known from this area has such a short and almost smooth style, the tubercles are irregular and appear on only a few fruits.

34. *Macaranga clemensiae* sp. nov.

Arbor usque 10 m. alta; ramulis et partibus novellis dense et laxiuscule tomentosis, pilis tenuibus crispis; stipulis crassiusculis, lanceolatis, 4.5 mm. longis, cito caducis; petiolis 5–9 cm. longis, glabris; laminis lanceolatis vel ovatis, 11.5–20 cm. longis, 3.7–7.5 cm. latis, acuminatis, acumine 1 vel 2 cm. longo, basi 0.3–0.7 cm. peltatis, margine valde recurvis, supra cito glabris, sub magnificatione nitidis, crasse bullatis, olivaceis, subtus brunnescentibus, primum laxiuscule tomentosis deinde glabris, dense granuloso-glandulosis, 3-nerviis, venis primariis supra basales 4–6 paribus oblique adscendentibus et curvantibus et anastomosantibus subtus prominentibus et elevatis, secundariis et rete conspicuis; ♂ inflorescentiis non visis; ♀ paniculis usque 14 cm. longis, laxiuscule tomentosis et tarde glabris, bracteis 1–2.5 mm. longis, triangulari-ovatis, floribus puberulis et granuloso-glandulosis, sessilibus vel subsessilibus; calyce 3-lobato, 2 mm. longo; ovario 2 mm. alto; stylo 6 vel 7 mm. longo, margine recurvo, adpresse papilloso; capsula immatura subglobosa, 5 mm. diametro, molliter echinato; echinis conicis glabris, 0.5–1.1 mm. longis.

NORTHEAST NEW GUINEA: mountain forest, Sambanga, alt. 1500–1800 m., *Clemens 7902A* (♀, A, TYPE), Dec. 10, 1937; same locality, *Clemens 7011* (♀, A), Sept. 1937 (small tree, diameter breast high 4"); same locality, *Clemens 7629* (♀, A), Nov. 1937 (tree 25–35 ft.); Ogeramnang, alt. 1800 m., *Clemens 4937* (♀, A), Jan. 1937.

This species differs from all others in the coarsely bullate leaves. On the lower surface the pockets between the reticulated veins are deeply concave, but not all in the same degree; however, they form a fairly definite pattern. At maturity only a remnant of the tomentum remains along the veins or veinlets. The granular glands are impressed and the lower surface of the dried leaves is brownish. In an occasional flower two styles were observed, but not any fruit with two seeds was seen. Another distinctive character of this species is to be noted in the glabrous conical processes.

35. *Macaranga womersleyi* sp. nov.

Arbor usque 12 m. alta; ramulis et petiolis tomentosis tarde glabrescentibus, partibus novellis et inflorescentiis omnino laxe ferrugineo-tomentosis, pilis crispulis; stipulis lanceolato-oblongis, apice obtusiusculis, ca. 8 mm. longis; petiolo 4–5 cm. longo; laminis subcoriaceis, ovatis, 9.5–15 cm.

longis, 4–6 cm. latis, sensim longe acuminatis, acumine 2–3 cm. longo, basi rotundatis et angustissime (ca. 2 mm.) peltatis, trinerviis, 5 vel 6 paribus supra basales, subtus prominentibus, rete prominulo, supra bullatis et glabris, subtus subvillosis-tomentosis et granuloso-glandulosis, venis majoribus villosulis, pilis ca. 1.5 mm. longis; paniculis ♂ immaturis ca. 7 cm. longis; bracteis florigeris late triangularibus, ca. 1.5 mm. longis, 2 mm. latis; alabastris granuloso-glandulosis, 1 mm. diametro; calycis laciniis . . . , staminibus 8–11, antheris 4-locularibus; inflorescentia ♀ ignota.

NORTHEAST NEW GUINEA: mountains near Nondugl, Central Highlands, alt. about 1950 m., *Womersley* NGF 4475 (♂, A, TYPE), Sept. 1951 (tree 40 ft. overall in mountain forest; crown sparse; leaves densely tomentose below, pale green above; flowers in brownish spikes; bark gray, finely fissured, underbark red, inner bark pinkish, $\frac{1}{4}$ " thick; wood white).

Although the general form of this collection suggests that of *M. longicaudata*, the pubescence everywhere on the two specimens is of an entirely different type. In *M. womersleyi* the hairs of the new bud (stipules and leaf) and all the inflorescence (axis, branches, bracts, and flowers) consist of crinkled fine hairs; this is true also of the underlayer of hairs on the lower surface of the leaves; the upper layer appears to be mostly on the veins and consists of separate fine, straight hairs. In *M. longicaudata*, on the other hand, the hairs are coarser, straight, and distinct except on the very young leaves; the stipules, the bracts of the inflorescence, and the flowers are glabrous, although the axis of the inflorescence and the branches are densely pubescent. In spite of the similarity in the shape of the leaves and the number of stamens, I cannot believe that the two collections represent the same species.

36. *Macaranga longicaudata* sp. nov.

Frutex ca. 2 m. altus; ramulis, petiolis, axibus inflorescentiarum dense hirtellis, pilis sub magnificatione nitidis; stipulis oblongis, apice fractis, 9 mm. longis, glabris et caducis; petiolo 1.5–3 cm. longo; laminis anguste ovatis, 7–13 cm. longis, 3–6 cm. latis, denticulatis, sensim caudato-acuminatis, acumine 2–3 cm. longo, basi rotundatis, supra conferte bullatis et glabris plerumque costa excepta, subtus dense reticulatis et atrofusco-granuloso-glandulosis, venis omnino hirtellis, trinerviis, venis primariis supra basales 9–13 paribus, novellis utrinque dense hirtellis; paniculis ♂ 3–9 cm. longis, ramis inferioribus usque 2 cm. longis; bracteis florigeris glabris ovatis vel lanceolatis, acuminatis, 1–2.5 mm. longis, concavis; alabastris subglobosis, 1 mm. diametro, glabris et leviter granuloso-glandulosis, calycis laciniis vel sepalis (incertis), staminibus 7–10, antheris 4-locularibus; inflorescentia ♀ ignota.

PAPUA: forest, main range NW of The Gap, alt. about 2400 m., *Carr* 15303 (♂, A, TYPE; BM), Jan. 1936 (shrub about 7 ft. tall, with red flowers).

This is a striking collection with finely bullate and long-caudate leaves closely reticulate on the lower surface. Under the microscope the hairs of

the branchlets, petioles, and inflorescence axes glisten. On the new leaves the pubescence is somewhat matted on both surfaces, but this disappears as the leaves mature, leaving a pubescent midrib above. On the lower surface all the veins support a sprinkling of these shining hairs. The venation is so deeply impressed that I cannot be sure whether the base is rounded and very narrowly peltate or has a very narrow and shallow sinus at the attachment of the petiole. The flower buds and the bracts of the inflorescence, in contrast to the axis and branches, are glabrous. For some reason — immaturity or mode of drying — I have been unable to separate the parts of the calyx, hence I am not able to say whether it is lobed or whether the sepals are separate.

37. *Macaranga leonardii* sp. nov.

Arbor 20 m. vel plus alta; ramulis, petiolis, costis stipularum et axibus inflorescentiarum villosis, pilis brunnescentibus tenuibus ca. 2 mm. longis tarde glabrescentibus; stipulis late ovatis, 1–2 cm. longis, ca. 0.7–1 cm. latis, praecipue apicem versus carinatis, marginem versus glabris et brunneis, subscariosis, caducis; petiolo 6–9 cm. longo; laminis coriaceis, in sicco rigidiusculis, ovatis, 13–26 cm. longis, (6.5–) 9–15 cm. latis, basi rotundatis et 0.4–1.5 (plerumque 0.7–1) cm. peltatis, acuminatis, acumine 0.5–2 cm. longo, novellis utrinque dense lanato-tomentosis, maturis supra glabris et bullatis, subtus lanato-tomentosis et granuloso-glandulosis, palmatinerviis 3 majoribus, supra basales venis primariis 7–11 paribus, secundariis supra impressis subtus manifestis; ♂ inflorescentiis usque 15 cm. longis, ramis usque 6 cm. longis; glomerulis saepe confertis, lanato-tomentosis; bracteis florigeris late ovatis, ca. 2.5 mm. longis; floribus post anthesin ca. 5 mm. longis; calyce 2–2.5 mm. longo, 3-lobato; staminibus 5–11, antheris 4-ocularibus rariter 3-ocularibus; ♀ inflorescentiis usque 17 cm. longis, pauci-ramosis, ramis usque 5 cm. longis, basi ramorum interdum foliis oblongis minimis, 1.5–2 cm. longis, 0.7 cm. latis, petiolo ca. 1 cm. longo; floribus sessilibus; bracteis anguste ovatis, ca. 5 mm. longis, 2.5 mm. latis, villosulis, intus non patellari-glandulosis glabris; calyce juvenili non viso, maturo 3-lobato extus villosulo, lobis 2–3 mm. longis, 1.7–2 mm. latis; ovario 1-oculari, molliter echinato, villosulo; stylo ca. 6 mm. longo, papilloso, dorso villosulo; capsula villosula, echinis 2–3 mm. longis, villosulis; semine ca. 4 mm. longo latoque, 3.5 mm. crasso, extus ruguloso, glabro, atro-brunnescente.

NETHERLANDS NEW GUINEA: forests of lower slopes and valley bottom, alt. 2750 m., *Brass 10969* (♂, TYPE, A), Oct. 1938 (common and conspicuous brown-foliaged tree attaining 20 m.); frequent in old secondary forest, same locality, alt. 2880 m., *Brass & Versteegh 10461* (♂, A), Oct. 1938 (tree 20 m. high, 31 cm. diameter, bark fairly smooth; wood rose; flowers brown); occasional in primary forest on slope of a ridge, 18 km. SW of Bernhard Camp, Idenburg River, alt. 2200 m., *Brass & Versteegh 12506* (♀, A), Feb. 1939 (tree 28 m. high, 42 cm. diameter; bark red-brown; wood light brown; fruit brownish green).

This is a very striking species, probably closest to *M. carrii*. It differs from the latter species in the peltate and somewhat stiffer leaves, and the 1-locular ovary. In the ♀ plant the leaves are less bullate and the stipules are slightly larger than those of the two ♂ plants.

This species is named for Mr. Leonard J. Brass whose work has contributed so greatly to the knowledge of New Guinean flora. An earlier described species, *M. Brassii*, named for him has been reduced to synonymy.

38. *Macaranga carrii* sp. nov.

Arbor ca. 6–24 m. alta; ramulis, petiolis, costis stipularum et axibus inflorescentiarum villosis, pilis brunnescentibus gracilibus 2–3 mm. longis tarde glabrescentibus; stipulis late ovatis 2–2.5 cm. longis, 1.3–1.8 cm. latis, acutis, marginem versus glabris margine pubescente; petiolo 2.5–9 cm. longo; laminis orbiculari-ovatis vel elliptico-ovatis, magnitudine variantibus 7.5×4.7 cm., 15×8.5 cm., 15.5×12.5 cm., 17×11 cm., acuminate, acumine 0.5–1 cm. longis, basi rotundatis vel inconspicue et leviter cordatis, novellis dense lanato-tomentosis, maturis supra glabrescentibus conspicue bullatis, subtus lanato-tomentosis et granulo-glandulosis, basi trinerviis vel breviter palmati-7-nerviis, supra basales venis primariis 5 vel 6 paribus supra impressis subtus prominulis, secundariis supra impressis; ♂ inflorescentiis 8–17 cm. longis breviter ramosis; bracteis extus villosis, ramigeris ca. 1.5 cm. longis 3-lobis, lobis gracilibus, florigeris lanceolatis ca. 5 mm. longis basi 2–2.5 mm. latis acuminatis; calyce 2–2.5 mm. longo granulo-glanduloso et pauci-piloso 3-lobato, lobis 1–1.5 mm. longis, staminibus 7–10, antheris 4-locularibus; ♀ inflorescentiis 10–16 cm. longis, bracteis stipuliformibus, calyce ♀ floris 2-lobato villosa, ovario 2-loculari, stylis 1–1.3 cm. longis dense plumosis dorso villosis; capsula immatura molliter echinata et villosa.

PAPUA: above The Gap, alt. about 2400 m., *Carr 13746* (♀, A, BM), Dec. 1935 (tree about 20 ft. tall; leaves brown-woolly beneath; fruit olive-brown); forest, Mt. Ganeve, alt. about 2550 m., *Carr 15288* (♂, A, TYPE; BM), Jan. 1936 (tree about 80 ft. tall; leaves brown-woolly beneath; flowers red).

A very striking species readily distinguished by the finely bullate leaves, the villous and lanate pubescence, the large staminate flowers with lobed calyces; the granular glands on the calyx are about twice as large as those which are characteristic of smaller flowers.

39. *Macaranga fragrans* sp. nov.

Arbor usque 25 m. alta; ramulis apud stipulas glabris lenticellatis crassis 1.3–2 cm. diametro; stipulis liberis puberulis 4–13 cm. longis, 2–3 cm. latis, apice anguste obtusis et interdum mucronatis; petiolo 18–52 cm. longo, glabro; laminis magnis vix subcoriaceis, 34–76 cm. longis, 27–48 cm. latis, orbiculari-ovatis latissime (7–20 cm.) peltatis, breviter acutis vel acuminatis, basi rotundatis, 9-nerviis, supra basin utrinsecus costa 7–9 nervis primariis, juventate supra sparsim pilosis subtus fere glabris, ma-

uritute utrinque glabris, subtus consperse et minute glandulosis, rete laxo; inflorescentiis ♂ paniculatis 24–49 cm. longis, fere a basi ramosis vel usque 12 cm. pedunculatis, axi inferiore glabro, versus apicem, etiam ramis et bracteis utrinque minute fulvo-tomentellis, ramis usque 18 cm. longis; bracteis ad basim glomerulorum usque 5 mm. longis, patentibus incurvis, semiorbicularibus acuminatis pectinato-laciniatis (laciniis 0.5–2 mm. longis), intus non patellari-glandulosis, multifloris; sepalis 3 vel 4 tomentellis, 0.5–0.7 mm. longis ovatis, staminibus 7–10, antheris 4-locularibus; pedicellis 0.3–1 mm. longis; infructescentiis paniculatis 34–43 cm. longis, pedunculo 5–12 cm. longo; ♀ floribus et bracteis non visis; capsulis 2 (interdum 3) -locularibus, tomentellis; coccis 0.9 cm. altis et crassis, 0.6 cm. latis, echinis 0.5–2 mm. longis cum minutis echinis intermixtis tectis; stigmatibus circiter 2 mm. longis, dense plumosis; seminibus fere levibus.

NETHERLANDS NEW GUINEA: occasional in secondary forest on edge of flood plain, Bernhard Camp, Idenburg River, alt. 70 m., *Brass & Versteegh 14025* (♂, A), April 1939 (tree 37 m. high, 50 cm. diam.; bark 8 mm. thick, gray-brown; wood red-brown).

PAPUA: common in seral forests on silt-loam soils of river flood plains, Palmer River, 2 miles below junction Black River, alt. 100 m., *Brass 7329* (♂, TYPE, A), *7329A* (♀, A), July 1938 (very conspicuous tree up to 25 m. or more high; leaves to about 90×60 cm., acute, peltate, crowded at the ends of the branches; panicles several, somewhat glaucous, at first axillary, later lateral close below the leaves; ♂ flowers minute, fragrant; seeds black, remaining attached to septum after fall of the valves of the fruit).

40. *Macaranga magnifolia* sp. nov.

Arbor ca. 9 m. alta; ramulis non visis; gemma terminali et stipulis lanceolatis persistentibus 6–7 cm. longis, flavo-setulosis, setulis 1.5–2 mm. longis; petiolo consperse setuloso fere glabro, paulo compresso; laminis coriaceis, orbiculari-ovatis, ca. 67 cm. longis, 60 cm. latis, basi late (17 cm.) peltatis, apice subabrupte et breviter acuminatis, supra costa et venis primariis consperse setulosis et puberulis ceterum glabris, subtus atrogranuloso-glandulosis et venis omnibus puberulis, palmatinerviis, venis primariis supra basales ca. 14 paribus prominentibus, secundariis prominulis, rete distincto; ♂ inflorescentia non visa; ♀ paniculis (in fructu tantum visis) ca. 9 cm. longis, axi et ramis dense tomentosis, bracteis rhombeis ca. 4 mm. longis, dentatis, utrinque tomentosis, caducis; calyce immaturo truncato-urceolato, tomentoso, vix 1.5 mm. alto; ovario dense granuloso-glanduloso, 2- vel 3-loculari, stylis (in fructu) brevissimis, 1 mm. longis, minute papillois; capsula 1–1.3 cm. lata, ca. 0.8 cm. alta, 0.7 cm. crassa, dense granuloso-glandulosa et tuberculata, tuberculis obtusis tomentosis, 0.5–0.7 mm. longis, 1–1.5 mm. latis; seminibus subglobosis fere 5 mm. diametro, insculptis.

PAPUA: rain forest, Wame River, Purari Delta, *Brass 1090* (♀, A, TYPE), March 1926 (erect tree 30 ft. high, with thin brown bark and pale wood; leaves very large and peltate, clustered at the ends of the branches; stipules persistent

long after the fall of the leaves; inflorescence axillary; fruit green, covered with yellow granular substance).

This collection was previously reported as aff. *M. strigulosa* Muell. Arg. (error for *M. stipulosa*). The latter species from Polynesia has entire bracts patelliform-glandular within. I am inclined to believe, from the one remnant of a bract which I found between fruits on the infructescence of *Brass 1090*, that it is more nearly related to *M. gigantea* (Reichb. f. & Zoll.) Muell. Arg. from Malaysia. The Malaysian species, however, has smooth rather than tuberculate fruits.

41. *Macaranga quadriglandulosa* Warburg in Bot. Jahrb. 13: 350. 1891. — Pax & K. Hoffmann in Pflanzenr. 63 (IV. 147. VII): 356 (incl. vars. *abbreviata* and *genuina*). 1914. — J. J. Smith in Nova Guin. Bot. 12: 546. 1917. — Mansfeld in Jour. Arnold Arb. 10: 232. 1929. — Kanehira & Hatusima in Bot. Mag. Tokyo 52: 411. 1938.

Macaranga tanarius var. *abbreviata* J. J. Smith in Nova Guin. Bot. 8: 238. 1910; l.c. 791. 1912.

Tree up to 20 m. high or sometimes a spreading shrub about 2 m.; young branchlets; stipules, and young leaves minutely puberulous or almost glabrous, rarely densely pubescent; stipules lanceolate, 1–2 cm. long, usually caducous; petioles 5–25 cm. long, glabrous or occasionally pilose, particularly around the apex; leaf-blades chartaceous or subcoriaceous, 7–33 cm. long, 4–25 cm. wide, orbicular-ovate with entire, infrequently sinuate or dentate margin, rounded or rarely truncate at the base and 1–5 cm. peltate, acuminate, palmately 7–9-nerved with 5–8 oblique primary veins from either side of the midrib, bearing on the basal nerves (between the insertion of the petiole and the margin) 1–4 (–8, or rarely none) oval glands, above glabrous, beneath densely and minutely glandular and occasionally puberulous, secondary venation visible but not prominent; ♂ panicle including peduncle (up to 11 cm.) up to 19 cm. long (in var. *abbreviata* up to 26 cm. long, including peduncle of 21 cm.); bracts subtending glomerules ovate, 3–5 mm. long, deeply concave and entire or sinuate, glabrous or minutely puberulous and minutely glandular, with a small hairy cushion at the base inside supporting the flowers of the glomerule on pedicels 0.5 mm. long; ♂ flower in bud about 0.5 mm. diameter, granulo-glandular; sepals 2 or 3, ovate, acute; stamens 2 or 3 with 4-locular anthers; ♀ inflorescence to 20 cm. long, simple or rarely branched, with flowers clustered at the apex (occasionally only a single flower), the outer bracts ovate, 5 or 6 mm. long, glabrous, the inner bracts obovate with the upper part sometimes lobed or very shortly pectinate-lobed and the lower portion narrowed and hairy inside toward the base, granulo-glandular; calyx globular narrowed into a short, scarcely dentate neck; styles 3–5 (–7) mm. long and densely papillose; ovary 3–5-locular; capsule usually densely granulo-glandular, depressed globose or ellipsoidal, near maturity including the processes about 2 cm. broad, processes 3–7 mm. long, glabrous and often granulo-glandular.

NETHERLANDS NEW GUINEA: in forest, Remore, Sorong, *Main* 501 (♀, A, BO), Aug. 1948; coastal plain, Hollandia, *Neth. Ind. For. Serv.* *bb.25073* (♂, A), July 1938; Eti River, upper Tami, *Gjellerup* 56 (♂, BO), April 1910; Giriwo River, *Janowsky* 140 (♂ & ♀, BO); in edge of secondary forest, Nabire, *Kanehira & Hatusima* 11427 (♀, A, BO), Feb. 1940; Canoe Camp, *C. Boden Kloss s. n.* (♀, BM); south of Geluks Hills, *Versteeg* 1711 (TYPE of var. *abbreviata*, ♂, BO), Sept. 1907; Bivouac Island, North River, *Pulle* 138 (♀, BO), Oct. 1912; near Kloof Bivouac, North River, *Pulle* 160 (♀, BO), Oct. 1912; North River, *Von Römer* 673 (♂, BO), Oct. 1909.

PAPUA: Veiya, *Carr* 11713 p.p. (♂, A), Mar. 1935; Kanosia, *Carr* 11094 (♂, A, BM, NY), 11531 (♂, A, BM, NY), Feb. 1935; Boridi, alt. about 1050–1200 m., *Carr* 14734 (♀, BM), 14861 (♂, A, BM), Oct., Nov. 1935; Port Moresby, *White* 20 (♂, BR), July 1918; Mafulu, alt. 1250 m., *Brass* 5186 (♂, A, BO), Sept.–Nov. 1933; same locality, *White* 511 (sterile, BR), July, Aug. 1918; Laloki River, alt. about 360 m., *Brass* 537 (♂ & ♀, A), Oct. 1925; Rona, Laloki River, alt. 450 m., *Brass* 3691 (♂, A, NY), April 1933; Hula, *Brass* 526 (♀, A), Oct. 1926; Domara River, *Brass* 1585 (♂, A), May 1926; Rigo area, Central District, *Turner s. n.* (♂, BR); Fife Bay, *Turner* 80 (♂, BR), Sept. 1930.

NORTHEAST NEW GUINEA: Bulolo, *Fryar*, NGF 3975 (♀, A), Feb. 1950; Kelel, alt. 150 m., *Schlechter* 16213 (♀, A, NY), June 1907; Keneyia, alt. 150 m., *Schlechter* 18437 (♀, A), Oct. 1908; Matap, alt. about 1500–1800 m., *Clemens* 11311 (♀, A), Feb.–April 1940; Boana, alt. 750–1050 m., *Clemens* 41612 (♀, A), May–Nov. 1940; on beach, Salamaua, *Kanehira* 4022 (♂ & ♀, A), 4023 (♀, A), Feb. 1937; in grey-brown sandy loam on alluvial flats beside Munim Waters, Second Austral For. Surv. Co., NGF 264 (♂, A, BR, LAE), July 1944; along creek bank, Yalu, *White*, *Dadswell*, *L. S. Smith*, NGF 1647 (♂, A, BR, LAE), July 1944.

BISMARCK ARCHIPELAGO: locality not on label but cited by Pax & Hoffmann as Kerawara, *Warburg* 20534 (♀, type-coll., A), 1889; Duke of York Islands, *Bradtko* 37 (♂ & ♀, BR), May 1917.

In addition to the above-cited specimens there are at hand three from Kajabit, Northeast New Guinea: *Clemens* 10522 (♂, A), July 1939, 10657 *bis* (♀, A), Aug.–Dec. 1939, and 40683 (♂, A), Aug. 1939; another from Kiapit (which I suspect is the same locality as Kajabit), NGF 2676 (♀, A); and a fifth collection from Hisiu, *Carr* 11374 (♀, A, BM, NY), Feb. 1935.

The last five numbers, although lacking the typical oval glands on the basal nerves of the upper leaf-surface, are characterized by ♂ inflorescences with entire or sinuate and glabrous bracts, ♂ flowers with two or three stamens with four-locular anthers, four-locular ovary, and fairly short and densely papillose styles; i.e., they have all the characters of this species except the glands on the basal nerves. It might here be noted that the position of these glands varies from near the insertion of the petiole to below the upper half of the vein, and sometimes leaves of the same collection will illustrate different positions. In one collection there were four glands very close to the margin as well as four near the middle of the veins; other specimens have only two glands or sometimes only one, or as noted above none.

In the material before me I have found none with only a two-locular ovary as described for var. *digyna* Pax & K. Hoffmann. Some specimens have fruits with three and four locules, more show four and/or five locules, one specimen had fruits with five and six locules, and in one the fruit appeared to be two- and three-locular, though the material was too scanty to be sure. Most fruits have four or five locules, or both may be found on a single specimen. The obvious character of var. *abbreviata* (J. J. Sm.) Pax & K. Hoffmann is the long-peduncled and short-branched ♂ inflorescence (a feature not mentioned by Pax & K. Hoffmann), as illustrated in *Versteeg 1711*, *Von Römer 673*, *Gjellerup 56*, and *Neth. Ind. For. Serv. bb.25073*. In the abundance of the material at hand this seems to represent nothing more than an ecological form of the species.

41A. *Macaranga quadriglandulosa* var. *variabilis* var. nov.

Arbor glabra usque ca. 9 m. alta; ramulis in sicco atrofusces; stipulis oblongis 9–10 mm. longis, basi 3.5 mm. latis, obtuse acuminatis, cito caducis; petiolo gracili, 3–10 cm. longo; laminis triangulari-ovatis acuminatis, acumine 1–2 cm. longo, basi truncatis vel 0.2–2 cm. peltatis, dentatis vel intermedium subintegris, supra prope basin maculari-biglandulosis vel eglandulosis, subtus flavo-glanduloso-punctatis, trinerviis vel breviter palmatinerviis, venis primariis supra basales 6–8 paribus, rete inconspicuo; paniculis ♂ usque 14 cm. longis, ramis inferioribus ca. 5 cm. longis; bracteis et ♂ floribus ut in specie; inflorescentiis ♀ verisimiliter simplicibus apice flores paucos gerentibus, bracteis et calycibus non visis; capsula 3-loculari, ca. 1 cm. alta et 1.5 cm. lata, dense granuloso-glandulosa et echinibus molli-bus tecta; stigmatibus ca. 3 mm. longis plumosis.

PAPUA: rain-forest regrowths, Kerema, *Brass 1204* (♂, A, TYPE), March 1926 (slender erect glabrous tree 20–25 ft.); Sogeri, alt. about 600 m., *Forbes 91* (♀, BM), Oct. 1885; Koitaki, alt. about 450 m., *Carr 12159* (♂, A, BM), May 1935 (tree 20 ft. tall; leaves with ± crimson glands at base of blades); stream bank in very steep hill forest, Rouna, alt. about 420 m., *Carr 12388* (♂, A, BM, NY), May 1935; Veiya, *Carr 11714* (♀, A, BM, NY), March 1935; Isuarava, alt. about 1050 m., *Carr 15601* (♂, A, BM), Feb. 1936.

The staminate inflorescence and the capsule with the granular glands covering not only the main part but also the lower part of the processes as well, are the characters which ally this variety with *M. quadriglandulosa*. The processes are about 6 mm. long. Here the capsule seems to be constantly 3-locular. In the species the capsule is 2–5-locular, but mostly 4- or 5-locular. In most of the collections cited for this variety the leaves are only very narrowly peltate or epeltate with two oblong (sometimes nearly orbicular) flat glands on the upper surface between the attachment of the petiole and the adjacent margin; sometimes only one gland is present, sometime none. *Carr 15601* has leaves which are one or two centimeters peltate, and hence it appears to form a transition to the species.

42. *Macaranga tanarius* (L.) Mueller Arg. in DC. Prodr. 15 (2): 997. 1866. — F. Mueller, Descr. Notes Pap. Pl. 2: 27. 1886. — K. Schu-

mann in Bot. Jahrb. 9: 206. 1887; in Notizbl. Bot. Gart. Berlin 2: 128. 1898. — Warburg in Bot. Jahrb. 13: 352. 1891. — K. Schumann & Lauterbach, Fl. Deutsch. Schutzgeb. Südsee 398. 1900. — J. J. Smith in Nova Guin. Bot. 8: 238. 1910; l. c. 8: 791. 1912. — Pax & K. Hoffmann in Pflanzenr. 63 (IV. 147. XIV): 352, t. 59. 1914. — Kanehira & Hatusima in Bot. Mag. Tokyo 52: 411. 1938.

Ricinus tanarius L. Spec. Pl. ed. 2, 1430. 1763.

Mappa tanaria Spreng. Syst. 3: 878. 1826. — F. Mueller, Descr. Notes Pap. Pl. 1: 7. 1875.

Macaranga clavata Warburg in Engl. Bot. Jahrb. 13: 349. 1891. — K. Schumann & Lauterbach, Fl. Deutsch. Schutzgeb. Südsee 396. 1900.

Macaranga tanarius var. *a tomentosa* (Bl.) Mueller Arg. in DC. Prodr. 15 (2): 997. 1866. — K. Schumann & Hollrung, Fl. Kais. Wilhelms Land 79. 1889. — K. Schumann & Lauterbach, Fl. Deutsch. Schutzgeb. Südsee 398. 1900.

Mappa tomentosa Blume Bijdr. 624. 1825.

Tree 10–20 m. high; branchlets, stipules, petioles, and new leaves puberulous or shortly villous and later glabrate or sometimes glabrous; stipules somewhat scarious, oblong or ovate, acuminate, 1–3 cm. long, 0.5–1.3 cm. broad, caducous; petioles 6–28 cm. long; leaf-blades suborbicular-ovate, 8–30 cm. long, 5–28 cm. broad, acuminate, broadly (2–7 cm.) peltate at base, repand-denticulate or entire, usually glabrous and eglandular on the upper surface but sometimes with 2–4 glands as in *M. quadriglandulosa*, rather densely granulo-glandular beneath and varying in pubescence from velutinous and shortly villous on the veins to glabrous, net-venation distinct, palmately veined with 6–9 pairs of primary veins above the basal ones; ♂ panicle 7–25 cm. long, pedunculate; bracts subtending the glomerules deeply concave, suborbicular-ovate, 4–7 mm. long, acuminate, pectinate-lacinulate or dentate, very often velutinous; ♂ flowers small, about 1 mm. long; sepals usually 3, stamens 4–14 with 4-locular anthers; ♀ panicle 5–30 cm. long with few branches or simple; floral bracts ovate, 0.9–2 cm. long, acuminate, pectinate-lacinulate; ♀ calyx closely covering the ovary, subtruncate, velutinous; ovary 2- or 3-locular, styles 4–8 mm. long, irregularly and slightly papillose; capsule glabrous, densely granulo-glandular and bearing practically glabrous processes, the processes somewhat remote, 5–15 mm. long.

NETHERLANDS NEW GUINEA: without further locality, *Warburg* 20692 (♂, A); in alangalang field, Kp. Opeko (Topeko), *Anta* 173 (♂, A, BO), July 1941; Soron, *Beccari* 8889 (P. P. 459) (♀, F); "Mt. Arfak a Putat," *Beccari* 8886 (P. P. 935) (♀, F); Nabire, *Kanehira & Hatusima* 11435 (♂, A); Oria (Oeta), Exp. *Lundquist* 163 (sterile, BO); hills north of Hollandia, *Neth. Ind. For. Serv.* bb.25090 (♂, A). Misool Is., *Pleyte* 847 (♂, BO). Japen-Biak, Kp. Baroe near Seroei, *Aet & Idjan* 239 (♂, BO).

NORTHEAST NEW GUINEA: Finschhafen, *Warburg* 20511 (♀, A, probable ISOTYPE of *M. clavata*); Busu River bush, Lae, *Clemens* 10468 (♂, A), July 1939; Bulolo, *Fryar* NGF 3974 (♂, A); Wau Garden area, *McAdam* 226 (♂, BR), Aug. 1938 (medium-sized tree; leaves up to 20" diam. on young trees

with petioles up to 25" long, sometimes with drip tips up to 2" long and very narrow; hairy thin stipules persist for some time giving the branch tips a shaggy appearance); Morobe, *Womersley* NGF 2918 (♂, A, LAE); Boana, above 1000 m., alt., *Clemens* 8468 (♀, A), 41727 (♂, A); vicinity of Kajabit Mission, alt. 240–600 m., *Clemens* 10628 (♂, A), 10648 (♂, A); in gray-brown sandy loam on alluvial flats beside Munim Waters, Yalu, 2nd Aust. For. Surv. Co. NGF 260 (♀, A, BR, LAE).

PAPUA: second-growth rain forest, Lake Daviumbu, Middle Fly River, *Brass* 7501 (♂, A), Aug. 1936 (tree 5 or 6 m. high; branchlets myrmecophilous); same locality, *Brass* 7721 (♀, A), Sept. 1936 (tree 10 m. high); Daru Island, *Brass* 6394 (♀, A), Mar. 1936 (the principal component of rain-forest second growths on the islands); on open grass ridges, Dagwa, Oriomo River, *Brass* 6008 (♀, A, BO, NY), 6009 (♂, A, BO, NY); Veiya, *Carr* 11713 p.p. (♂, A, BM, NY); Isuarava, alt. about 1500 m., *Carr* 15574 (♂, A, BM); on rich gray sandy loam in Dobodura Plain — Giuri River — Soputa area, Buna hinterland, alt. about 100 m., *Cavanaugh & Fryar* NGF 2045 (♂, A, BR, LAE); Fife Bay, by a sago swamp, *Turner* 26 (♀, BR).

BISMARCK ARCHIPELAGO: New Britain: suburb of Rabaul, *Kanehira* 3996 (♂, A).

SOLOMON ISLANDS: Bougainville: Karngu, Buin, *Kajewski* 2254 (♂, A); Korniguru, Buin, alt. 900 m., *Kajewski* 2104 (♂, A). Guadalcanal: without further locality, alt. about 200 m., *Pendleton* 463 (♂, A), July 1944 (large shrub or small tree 4 m. tall, forming dense groves in areas where rain forest has been destroyed, also in edges of rain forest). San Cristoval: Manihuki, *Brass* 2616 (♂, A).

This is indeed a variable species as to pubescence, size of the bracts subtending the glomerules, and the number of stamens. However, I have been unable to find any combination in the characters which might serve as distinctive for the varieties which have been established and discarded at various times. Most of the material would fall under the so-called var. *tomentosa*. *Kajewski* 2254, *Pendleton* 463, and *Brass* 2616 are almost glabrous collections. In *Brass* 2616 there are only a few scattering hairs on the very young leaves and stipules; in *Kajewski* 2254 the young leaves and stipules are densely hairy, but the mature leaves are glabrous, and the axis of the inflorescence is puberulous; in *Pendleton* 463 only the branchlets of the inflorescence are puberulous, but in the *Brass* specimen the inflorescence axis and its branchlets are glabrous. The following specimens have glands on the leaves, as in *M. quadriglandulosa*, but the bracts of the inflorescence are like those of this species: *Carr* 11713, *Warburg* 20692, *Clemens* 41727, *Brass* 6009, and 7501, *Pleyte* 847, *Neth. Ind. For. Serv.* 25090, *Kanehira & Hatusima* 11435; the number of glands varies from one to four. Two collections from Biak Island, *Britton* 39 and 86 (♂ & ♀, A) probably belong here. The bracts of the ♂ collection are very small and apparently entire, but the specimen agrees in other details with this species; possibly this represents the form *brevibracteata* Mueller Arg.

43. *Macaranga hoffmannii* nom. nov.

Macaranga acuminata Pax & K. Hoffmann in Pflanzenr. 68 (IV. 147. XIV): 28. 1919; non Ridley (1916).

Tree 10–20 m. high with slender glabrous and sparsely granulo-glandular young growth; stipules not seen; petiole 2–3.5 cm. long, glabrous and slender; leaf-blades coriaceous, entire, ovate or ovate-lanceolate, 7–12 cm. long, 2.5–4 cm. broad, caudate-acuminate, narrowed towards the base and narrowly peltate, glabrous above, very sparsely pilose on the midrib beneath and very densely impressed-granulo-glandular, 3-nerved and shortly palmate-nerved, the primary veins 2–4 pairs above the basal ones; ♂ panicle branched almost from the base, 4–6 cm. long, glabrous and granulo-glandular; bracts denticulate, not patelliform-glandular within, the lower oblong, 2 mm. long, the upper triangular, glomerules 10–20 flowered; ♂ flower 2 mm. broad; sepals 3, elliptic, acute, densely granulo-glandular; stamens 10–12 with 4-locular anthers; ♀ flowers unknown.

Two collections cited in the original, *Ledermann 12685* and *12957*, were found on Felsspitze, Northeast New Guinea. The only pubescence mentioned in the description is that along the midrib on the lower surface of the leaves.

44. *Macaranga versteeghii* sp. nov.

Arbor 5–13 m. alta; partibus juvenilibus ferrugineo-tomentosis deinde glabratis; stipulis oblongo-lanceolatis, ca. 5 mm. longis, acutis vel subacuminatis, rigidiusculis, cito caducis; petiolo 2–5.5 cm. longo, glabrato; laminis maturis coriaceis, 7.5–16 cm. longis, 3.7–9.5 cm. latis, elliptico-ovatis, abrupte acuminatis, acumine 1–1.7 cm. longo, basi rotundatis et 0.5–0.7 cm. peltatis, supra glabris, subtus impresse sanguineo-granuloso-glandulosis et glabris vel costa venisque flocculoso-tomentosis, trinerviis et breviter palmatinerviis, venis primariis 5–7 paribus supra basales, supra impressis, subtus prominentibus, venis secundariis prominulis, rete utrinque manifesto; ♂ paniculis 5–7 cm. longis, ferrugineo-tomentosis, valde juvenilibus tantum visis; bracteis majoribus lanceolatis, 3.5 mm. longis, minoribus late ovatis, 1.5 mm. longis, abrupte et minute acuminatis, non patellari-glandulosis; alabastris ♂ tomentulosis et granuloso-glandulosis; staminibus 9–12, antheris 4-locularibus; ♀ inflorescentiis 5–8 cm. longis, sparsim et brevissime ramosis; calyce 3-lobato; ovario tomentuloso et granuloso-glanduloso; stylo 1 (vel 2) ca. 5 mm. longo, minute papilloso; capsula subglobosa, vix 5 mm. diametro, glabrata et granuloso-glandulosa, inermi vel interdum minute tuberculata.

NETHERLANDS NEW GUINEA: primary forest, Bele River, 18 km. NE of Lake Habbema, alt. about 2220 m., *Brass & Versteegh 11116* (♂, A, TYPE), Nov. 1938 (rare substage tree 13 m. high, 30 cm. diameter, with narrow crown; bark fairly smooth, brown; wood rose); abundant in seral forest of lower slopes, Bele River, 18 km. NE of Lake Habbema, alt. 2200 m., *Brass 11398* (♀, A), Nov. 1938 (second growth tree 5–7 m. high, with stiff peltate leaves).

It is to be noted that there are several fruits with two styles attached, but when the fruit is opened only one locule appears to have developed. I have seen only one fruit with two locules and two seeds.

45. *Macaranga trichanthera* sp. nov.

Arbor alta gracilis; partibus juvenilibus brunnescenti-tomentosis, tarde glabrescentibus; stipulis ca. 3 mm. longis, rotundato-ovatis, cito caducis; petiolo 2.5–6 cm. longo; laminis integris, elliptico-ovatis vel rhombeo-ovatis, 3.5–13 cm. longis, 2.5–9 cm. latis, acuminatis vel interdum acutis, acumine usque 1.5 cm. longo, basi rotundato-cuneatis et 0.1–0.7 cm. peltatis, novellis supra floccoso-tomentosis, maturis supra glabris et sub magnificatione reticulatis, subtus brunnescenti-tomentosis et granuloso-glandulosis, trinerviis vel in foliis manifeste peltatis breviter palmatinerviis, venis primariis 5–7 paribus supra basales, obliquis, prope marginem arcuatis et anastomosantibus, prominentibus, secundariis prominulis; ♂ paniculis 4–9.5 cm. longis, brunnescenti-tomentosis, vix floccosis, glomerulis plerumque confertis; bracteis florigeris parvis, ca. 1 mm. longis latisque, obtusis, intus non patellari-glandulosis; calyce 3-lobato, staminibus 3–5, antheris pilosis, pilis paucis brunnescentibus, 4-locularibus; ♀ inflorescentia usque 8 cm. longa, simplici (?), floribus sessilibus, bracteis incertis; calyce 2-lobato, 1.5–2 mm. alto; ovario 2-loculari, pubescente et granuloso-glanduloso; stylis 2, ca. 6 mm. longis, papillois, basi 1.5 mm. connatis; capsula inermi, 1 cm. lata et alta, ca. 0.7 cm. crassa, seminibus rugulosis.

NETHERLANDS NEW GUINEA: occasional on slopes in primary forest, 15 km. SW of Bernhard Camp, Idenburg River, alt. about 1900 m., *Brass & Versteegh 11953* (♀, A), Jan. 1939 (tree 28 m. high, 66 cm. diameter; fruits brown, ♀ flowers yellow-green; bark dark brown and fairly rough; wood light brown).

PAPUA: common in valley forest, Mt. Tafa, Central Division, alt. about 2400 m., *Brass 5077* (♂, A, TYPE), Sept. 1933 (tall and rather slender tree with small open crown; leaves pale green above, brown-pubescent beneath, giving the tree a brownish appearance); forest, Alola, alt. about 1600 m., *Carr 13671* (♀, A), Dec. 1935 (tree about 15 ft.); forest, The Gap, alt. about 2000 m., *Carr 13713* (♂, A), Dec. 1935 (tree about 70 ft. high).

NORTHEAST NEW GUINEA: Sutherland's Camp, Kaindi, alt. about 2100 m., *McAdam 245* (♂, BR), Aug. 1938 (small tree 6" diameter broken by falling tree; leaves broadly ovate to deltoid, green above, densely covered with rusty brown hairs underneath, thus giving the head of the tree a brown appearance, young leaves densely rusty on both surfaces); Ogeramang, alt. about 1770 m., *Clemens 4829* (very young ♀, practically sterile, A), *5055* (♂, A), *5533* (♂, A), Jan., Feb. 1937.

In the material cited, the leaves of half of the collections are barely peltate or epeltate. Those of *Brass & Versteegh 11953* and *Carr 13671* and *13713* are obviously peltate, while those of *McAdam 245* are both peltate and epeltate. The pubescence of this species is not so compact as that of *M. induta* and the leaves are different in outline; nevertheless,

probably on account of the persistent brown pubescence on the lower surface of the leaves, there is a resemblance between the two. *Macaranga trichanthera* differs from all the other species examined in having a few brownish and wrinkled hairs attached to the back of the anthers. The fruits do not have any processes or tubercles, if I have matched correctly ♂ and ♀ specimens, but are consistently two-locular, and the styles appear to persist longer than in the other species.

46. *Macaranga induta* sp. nov.

Arbor usque ca. 15 m. alta; partibus juvenilibus tomentosis, pilis tenuissimis crispis; stipulis 3.5–6 mm. longis, oblongo-linearibus, acutis, cito caducis; petiolo 2.5–6.5 cm. longo, glabrato; laminis ovatis vel ovato-lanceolatis, acuminatis, 8–15.5 cm. longis, 3–10.5 cm. latis, basi cuneato-rotundatis et 0.3–0.8 cm. peltatis, maturis supra glabris, subtus tomentosis et granuloso-glandulosis, trinerviis et breviter palmatinerviis, venis primariis 7–9 paribus supra basales, subtus prominentibus, secundariis prominulis; ♂ paniculis 6–9 cm. longis, tomentosis et dense granuloso-glandulosis; bracteis florigeris late ovatis, ca. 2 mm. longis, basi concavis, acutis vel obtusiusculis, intus non patellari-glandulosis; calyce 3- vel 4-lobato, staminibus 10–15, antheris 4-locularibus; ♀ inflorescentiis saepissime racemosis vel 1–2-ramosis; ♀ floribus primum simulate sessilibus demum in pedicellis usque 1 cm. longis; bracteis florigeris ovato-lanceolatis, acuminatis, ca. 3.5 mm. longis, cito caducis; calyce 4 mm. longo, tubuloso apice 2-lobato deinde rumpente et caduco; ovario pubescente, 2- vel 3-loculari, stylis 2 vel 3, ca. 8 mm. longis, dorso pubescentibus, dense papillois, rectis apice recurvis; capsula immatura dense granuloso-glandulosa et irregulariter vel non molliter echinatis, echinis 1.5 mm. longis, basi pubescentibus et 0.5 mm. latis.

PAPUA: forest, Alola, alt. about 1700 m., *Carr 13888* (♀, A, BM), Dec. 1935 (tree about 20 ft. tall); Uniri River, alt. about 1950 m., *Carr 15185* (♂, A, BM), Jan. 1936 (tree 30 ft. high).

NORTHEAST NEW GUINEA: open forest, Yunzaing, alt. about 1350 m., *Clemens 3394 bis* (♂, A), Aug. 1936 (tree 50 ft. high); same locality, *Clemens 3714* (♂, A), July 1936 (tree 50–60 ft. high); same locality, *Clemens 6568* (♀, A, TYPE), July 1937.

All the collections cited above are poor specimens. Those from Yunzaing show a greater variation than those from Papua in the size and shape of the leaves. It should be pointed out that the fruit of *Carr 13888* does not appear to be developing any processes, but the young flower with calyx looks very much like that of the Clemens collection designated as the type.

47. *Macaranga albescens* sp. nov.

Arbor alta; ramulis, stipulis, petiolis, foliis novellis et inflorescentiis dense tomentosis, pilis crassiusculis (demum caducis) et tenuissimis aliquatenus intermixtis; stipulis ca. 4 mm. longis, lanceolato-linearibus, caducis; petiolo

2–10 cm. longo; laminis 5–14 cm. longis, 3.5–9 cm. latis, suborbiculari-ovatis, undulatis, subcoriaceis, subabrupte et breviter acuminatis, basi subtruncatis vel cuneatis deinde rotundatis et 0.3–0.7 cm. peltatis, maturis supra glabris et conferte reticulatis, subtus minute et dense tomentosis et granuloso-glandulosis, trinerviis et breviter palmatinerviis, venis primariis 5–7 paribus supra basales prominentibus, secundariis prominulis; ♂ paniculis granuloso-glandulosis, ca. 5 cm. longis nondum maturis, glomerulis fere confertis; bracteis florigeris parvis, ca. 0.5 mm. longis, non patellari-glandulosis; calyce ca. 1.5 mm. longo 2-vel 3-lobato, prope apicem granuloso-glanduloso et tomentoso; staminibus 5–11, antheris 4-locularibus; ♀ inflorescentiis 6–9 cm. longis vel plus; pedicellis usque 5 mm. longis; calyce irregulariter 3–4-lobato; capsula 1-loculari inermi subglobosa, ca. 6 mm. diametro, tomentosa et granuloso-glandulosa; stylo (in fructu tantum viso) papilloso; semine brunnescenti ruguloso, ca. 4 mm. longo latoque.

NORTHEAST NEW GUINEA: Sarawaket, *Clemens 5632* (♀, A), Mar. 1937; mountain forest, same locality, alt. 1800–2400 m., *Clemens 7550B* (♂, A, TYPE), Nov. 1937 (tall tree); marsh meadow camp, vicinity of Samanzing, alt. 2100–2400 m., *Clemens 9484A* (♀, A), Jan. 1939 (treelet 3" diameter); high forest on mountain, Sambanga, alt. 1500–1800 m., *Clemens 6955* (♂, very young, A), Sept. 1937 (tall tree 2 ft. diameter); Sutherland's Camp, Kaindi, alt. about 2100 m., *McAdam 239* (♂, A, BR), Aug. 1938 (tall, dark, somewhat fluted, lumpy-boled tree 45/60/100; crown open with leaves pale green above and pure white underneath due to a very dense white bloom; twigs, petioles, and lower leaf-surface all heavily covered with it; bark dark brown; blaze red-brown with light brown line at sapwood).

PAPUA: common in valley forests, alt. 2500 m., *Brass 5081* (♀, A), May–Sept. 1933 (tree 25–30 m. with thinly foliated rounded crown; fruit oblique).

The pubescence of this species on the new growth, as observed under a lens, has distinct and longish wrinkled hairs covering or mixed with a rather compact layer of fine tomentum of shorter hairs. Later the longer hairs fall off leaving a minute tomentum on the branchlets, petioles, lower surface of the leaves, and inflorescences; the tomentum on the upper surface of the leaves, although not loose, disappears in spots, as if floccose, until finally none is left except at the attachment of the petiole. In most of the collections the lower surface of the dried leaves is brownish gray with flecks of white, but in *McAdam 239* and an older leaf of *Clemens 6955* the lower surface has a whitish tinge. Apart from the pubescence the species is characterized by narrowly peltate, orbicular-ovate leaves; ♂ flowers with calyx-lobes about half the length of the calyx; five to eleven stamens with four-locular anthers; and small, smooth, one-locular capsules.

In addition to the above cited specimens I have two from Netherlands New Guinea: *Brass & Versteegh 10482* (♂, A), rare in old secondary forest at 2680 m. altitude, collected 9 km. NE of Lake Habbema; and *Kanehira & Hatusima 13908* (♀, A), collected at 1900 m. altitude, in the fringing forests by Iray, Lake Giji. These differ from the others, as far as I can see, only in having the two basal lateral nerves ascending much nearer the margin than those in the other collections cited.

48. *Macaranga nova-guineensis* J. J. Smith in Nova Guin. Bot. 8: 789, t. 138. 1912. — Pax & K. Hoffmann in Pflanzenr. 63 (IV. 147. VII): 363. 1914.

Shrub; branchlets, stipules, petioles, young leaves, and the peduncles of the inflorescences densely velvety-pubescent with yellowish hairs 0.5–0.7 mm. long; stipules erect, subulate, caducous; petioles 1.3–5 cm. long; leaf-blades elliptic or oblong, 9–22 cm. long, 4.5–10 cm. broad, subabruptly acuminate with the narrow acumen 1–2.5 cm. long, rounded or obtuse and very shallowly cordate at the base, denticulate, on both sides slightly rough with very short hairs, only on the veins densely velutinous, feather-veined with 9–12 pairs of conspicuous primary veins curving upward and anastomosing near the margin, the reticulations distinct on the lower surface; inflorescence unisexual or androgynous; ♂ panicle with very few (3) branches, about 5.5 cm. long; bracts somewhat clasping the rachis, semiorbicular-triangular, about 1.3 mm. long, 2 mm. broad, acuminate, densely hairy beneath; ♂ flower short-pedicellate and towards the apex sparsely pilose; calyx tripartite, the 3 stamens with 4-locular anthers; ♀ inflorescence simple (?), peduncle about 15.5 cm. long, capsule covered with hairy processes up to 6 mm. long, 2-locular.

NETHERLANDS NEW GUINEA: in primary forest of the plain, North River, *Von Roemer* 514 (♂ & ♀, TYPE, BO), Oct. 1909.

PAPUA: sporadic in undergrowth of ridge forests, alt. 80 m., *Brass* 6643 (♀, A), May 1936 (shrub of erect or ascending habit 1–1.2 m. high; leaf-nerves purple beneath; fruit red); in rain forests, Aroara, Vailala River, alt. about 60 m., *Brass* 1061 (♀, A), Feb. 1926 (loosely branched bush about 1.5 m. high, with red fruit).

The specimen from the Bogor Herbarium has a small ♂ inflorescence, as shown in plate 138 cited above, also a very short inflorescence on the same branch below it, possibly the androgynous inflorescence to which the author refers; separate from the branch is the rachis of the long ♀ inflorescence, and immature fruits in a pocket. The collections from Papua have dark granular glands on the under surface of the leaves. These glands are not mentioned in the original description, and I do not find them on the single leaf of the Bogor specimen showing the lower surface; nevertheless I believe the Papuan specimens belong to this species. Perhaps it should be noted that *Brass* 1061 has been previously determined as *M. subpeltata*; unfortunately, none of the bracts of the inflorescence remains in a condition good enough to give a clue to its relationship. Further, the only bract seen with the type specimen of *M. nova-guineensis* was loose, and the ♀ bracts are not mentioned in the original description. This only underlines the necessity for more material before the species can be known in all its aspects. The type of *M. nova-guineensis* is the only material of *Macaranga* which I have seen with both ♂ and ♀ flowers on the same plant and on the same inflorescence.

49. *Macaranga subpeltata* Lauterbach & K. Schumann in K. Schumann & Lauterbach, Fl. Deutsch. Schutzgeb. Südsee 400. 1900.—Pax & K. Hoffmann in Pflanzenr. 63 (IV. 147. VII): 359. 1914.

Tree 10 m. high with the new growth fulvous-tomentulose, tardily glabrescent; stipules lanceolate or ovate, acute, 3–6 mm. long, caducous; petioles 3.5–10 cm. long, tomentulose; leaf-blades chartaceous, entire, ovate or ovate-oblong, 15–28 cm. long, 8–16 cm. broad, subabruptly acuminate, rounded and slightly cordate at the base, on the upper surface pubescent only on the midrib and primary veins, inconspicuously maculo-glandular near the base, scabrous-pubescent with very short hairs on veins and veinlets beneath and minutely dark-glandular punctate, 3-nerved with 7–10 pairs of primary veins above the basal ones; ♂ panicle 12–20 cm. long, pedunculate; ♂ flowers crowded at the apices of the branches; bracts subtending the many-flowered glomerules rhombic, incised-dentate, 2–3 mm. long; ♂ flower scarcely 1.5 mm. broad; sepals 3, sparsely pilose; stamens 3 with 4-locular anthers; ♀ inflorescence 2.5–11.5 cm. long, tomentulose, with ♀ flowers only at the apex, but with sterile bracts scattered along the peduncle; the terminal bracts rhombic or oblong-ovate, acuminate, dentate, 7–12 mm. long, sparsely patelliform-glandular; calyx cupular with short lobes, hardly 1 mm. long; ovary 2-locular, covered with processes; styles 4–5 mm. long, plumose; capsule 14 mm. broad without the processes, the processes pilose, 7–10 mm. long.

NORTHEAST NEW GUINEA: Keneyia, alt. 150 m., *Schlechter* 18330 (♂, A, BR), Oct. 1908.

50. *Macaranga ovatifolia* Merrill in Philip. Jour. Sci. 16: 562. 1920.

A small tree with the new growth at the tips of the branchlets, the young leaves and the inflorescences all ferrugineous-tomentulose, otherwise glabrous; stipules lanceolate, about 1 cm. long, caducous; petioles up to 17 cm. long; leaf-blades ovate, acuminate, 9–25 cm. long, 5–18 cm. broad, truncate at the base and very inconspicuously cordulate (in material here cited very shortly truncate-cuneate), 3-nerved with 8–11 pairs of primary veins above the basal ones, very densely granulo-glandular beneath; ♂ panicles up to 12 cm. long, the bracts subtending the glomerules somewhat obovate, 3–5 mm. long, 1.7–2.7 mm. broad, dentate with short (0.3–0.5 mm.) teeth and tomentulose on both surfaces; calyx 2- or 3-lobed; stamens 3 or 4 with 4-locular anthers; ♀ panicle 6–9 cm. long, the bracts similar to those of the ♂ panicle; capsules sometimes globose, 4 mm. diameter or broader, 1- and 2-locular, granulo-glandular and smooth; style 1 mm. long, minutely papillose.

SOLOMON ISLANDS: Bougainville: rain forest, Kieta, sea level, *Kajewski* 1534 (♂, A), March 1930 (tall shrub up to 7 m. high; bracts of buds pink); Kieta, alt. 100 m., *Kajewski* 1603 (♀, A), March 1930; rain forest close to sea beach, Karngu, Buin, *Kajewski* 2287 (♀, A), Oct. 1930 (medium-sized tree up to 25 m. high); Siwai, *Waterhouse* 169 (♂, A, NY), Dec. 1932. Shortland Islands: secondary growth in old gardens, lowland rain forest, near Aliang, *Walker* BSIP 296 (♀, A, BR).

There is at hand an isotype of *M. ovatifolia* Merr. as well as two other ♀ collections. The description of the ♂ inflorescence is drawn from *Kajewski 1534*. There is a tendency towards small macular glands on the upper surface of the leaves near the attachment of the petiole in the material here cited, but not in the Philippine material. Staminate material from the Philippines is necessary to complete the species, and to verify whether this material is correctly assigned to *M. ovatifolia*; there is great similarity in the terminal buds, bracts, and capsules, as well as in the general outline and lower surface of the leaves. I have seen also two sterile collections from the Admiralty Islands, *Hepplethwaite 544* and *563*, which appear to belong here.

51. *Macaranga fimbriata* S. Moore in Jour. Bot. 61: Suppl. 48. 1923.

Large tree with young growth (branchlets, stipules, petioles, and leaf-blades) ferrugineous-tomentulose but usually very soon glabrate; the oblong stipules 3.5–5 mm. (sometimes almost 1 cm.) long and caducous; petioles 3.5–8 cm. long; leaf-blades variable in form and size, ovate-oblong or lanceolate or elliptic, acute or shortly acuminate, 8×3.5 cm., 9.5×3 cm., 15.5×7 cm., 17×5.5 cm., 21×9 cm., at base rather obtusely cuneate and 2–4 maculo-glandular on the upper surface, beneath densely and minutely granulo-glandular and mostly glabrous, although with fragments of the pubescence here and there along the midrib and main veins, feather-veined or shortly 3-nerved at base, with 6–8 pairs of primary veins above the basal ones and almost equally distinct on both surfaces, the secondary venation inconspicuous; ♂ panicle loosely branched, 6–14 cm. long, fulvous-tomentulose; bracts 4.5–5 mm. long, often 5 subtending the glomerules at the tip of a branchlet, ovate or suborbicular and fimbriate with about 12 (in cited specimens 5–7) slender processes 1–2.5 mm. long; sepals 3 or 4 minutely fulvous-tomentulose at the apex; stamens (3–) 5–8 with 4-locular anthers; ♀ panicle up to 7 cm. long with several widely spreading branches 1–3 cm. long, the bracts similar to but smaller (3 or 4 mm. long) than those of the ♂ panicle; young flower 1.5 mm. high, cup-like pubescent calyx about 1 mm. high; ovary 2-locular and densely granulo-glandular, styles 1–1.5 mm. long, shortly papillose; capsule 3.5 mm. high, 5 mm. wide; seed 2.5 mm. diameter, finely sulcate.

PAPUA: common in drier parts of rain forest, Lake Daviumbu, Middle Fly River, *Brass 7494* (♀, A), Aug. 1936 (substage tree 12–15 m. high; leaves pale underneath; young fruit viscid); on rain-forest margin, Milne Bay area, about 6 miles up the Dawa Dawa River, alt. about 45 m., *L. S. Smith NGF 1319* (♂, A, BR, LAE), Mar. 1945 (tree 60 feet over all, with pale brown sparsely lenticellate bark; inflorescences creamy green).

NORTHEAST NEW GUINEA: on crest of ridge in foothill forest, August River, Sepik District, *Womersley NGF 3842* (♂, A), Sept. 1949 (small tree up to 20 feet high; flowers creamish, on long peduncles; bark gray-brown outside, rather flaky; inner bark red with wedges of whitish tissue); Quembung, alt. about 600 m., *Clemens 2155* (♂, A), March 1936.

51A. *Macaranga fimbriata* var. *doctersii* var. nov.

A forma typica differt foliis majoribus 13–31 cm. longis, 5–16 cm. latis, glabris, ovatis acuminatis; staminibus 2–5.

NETHERLANDS NEW GUINEA: Rouffaer River, alt. about 250 m., *Docters van Leeuwen* 10257 (♂, A, TYPE; BO), Sept. 1926; rain forest of the lower mountain slopes, Bernhard Camp, Idenburg River, alt. 170 m., *Brass* 13866 (♂, A), Apr. 1939 (tree 22 m. high, 30 cm. diameter); Andai, *Beccari* 8887 (♂, F).

52. *Macaranga polyadenia* Pax & K. Hoffmann in Pflanzenr. 68 (IV. 147. XIV): 25. 1919.

Slender glabrous tree 10–25 m. tall; linear stipules 4–5 mm. long; petiole 3–5 cm. long; leaf-blades entire, ovate-lanceolate, acuminate, 7–12 cm. long, 3–5.5 cm. broad, narrowed towards the very shallowly cordulate base, with 4–8 glandular spots on the upper surface near the attachment of the petiole, very densely granulo-glandular beneath, feather-veined with 6–9 pairs of primary veins; ♂ panicle puberulous, 6–8 cm. long, branched almost from the base; bracts crowded at the apex and along the branchlets, up to 5 mm. long, spatulate with the apex palmately parted into long teeth; flowers in bud only, puberulous; stamens 7 or 8 with 4-locular anthers; ♀ panicle 4–8 cm. long, branching less than the ♂, the bracts small; calyx ♀ cupular and 2- or 3-lobed; ovary smooth and densely granulo-glandular, 1-locular; style 1.5 mm. long, papillose.

The basis of this species is *Ledermann* 8664 and 8677 from the April River at 100 m. alt. It differs from *M. fimbriata* in being glabrous and having 1-locular capsules, otherwise the two are very close, according to the original descriptions.

53. *Macaranga villosula* Pax & K. Hoffmann in Pflanzenr. 68 (IV. 147. XIV): 27. 1919.

Tree 4–8 m. high with young growth grayish short-villous, tardily glabrescent; stipules small and falling very soon; petiole 4.5–9 cm. long, slender, villous; leaf-blades chartaceous, 13–18 cm. long, 5–7.5 cm. broad, ovate or oblong, acuminate, rounded at the base, entire or repand-denticulate, longish setulose on the upper surface, the veins more densely covered with a mixture of long and short hairs, at the base maculo-biglandular, more densely hairy and granulo-glandular beneath, pinnately veined, the primary veins 12 or 13 pairs; ♂ panicle 5–7 cm. long, branched almost from the base, the 5 or 6 bracts and the several-flowered glomerules subtended by them densely congested simulating a sessile or pedicellate head of flowers, the bracts about 2 mm. long, broadly ovate, 2-lobed at the base, granulo-glandular on both sides, ♂ flower short-pedicellate; calyx hardly 1 mm. long, clavate, pubescent; stamens 3 with 4-locular anthers; ♀ panicle on a short peduncle; bracts 1 mm. long, triangular, acute; pedicels 2–5 mm. long; ♀ flower with 3 triangular acute sepals;

ovary 1-locular, smooth, densely granulo-glandular, the style 4 mm. long, filiform, remotely papillose; capsule about 3 mm. diameter.

I have not seen either collection cited in the original (*Ledermann 9787* and *10593*), and I do not seem to have any specimens to match the description.

54. *Macaranga gracilis* Pax & K. Hoffmann in *Pflanzenr.* 68 (IV. 147. XIV): 31. 1919.

Glabrous tree up to 10 m. high with slender branchlets (2–2.5 mm. diameter at 15 cm. below the apex); the linear stipules 3–6 mm. long and caducous; petioles 1–3 cm. long; the lanceolate 1.5–3 cm. caudate-acuminate leaf-blades 6–13 cm. long, 1.5–3.7 cm. broad, with obtuse or subcuneate base, not maculo-glandular above but sparsely granulo-glandular on both surfaces and distinctly reticulate, 3-nerved at the base (the two laterals extending about half the length of the blade) with 4–6 additional pairs of curved ascending primary veins; the slender and scattered granulo-glandular ♂ panicle 3–6 cm. long, sometimes sparsely branched or almost simple, with 1–6-flowered glomerules subtended by a very small eglandular (or 1-glandular in original description) triangular bract; sepals 2 or 3, ovate and acutish; stamens 10–16 with 4-locular anthers; the ♀ inflorescence 5–8 cm. long with 2 or 3 branches bearing a single flower at the apex of each, the bracts stipule-like, 1.7 mm. long; calyx almost tubular, 2-lobed at the apex, 2–2.5 mm. long, quickly splitting; style to 1.5 cm. long bearing on one side a smooth stigma 1.3 cm. long; capsule about 5 mm. diameter, subglobose; seed smooth.

NETHERLANDS NEW GUINEA: frequent in mossy forest seral growths, 15 km. SW of Bernhard Camp. Idenburg River, alt. 1800 m., *Brass 12052* (♂, A), *12059* (♀, A), Jan. 1939 (slender tree attaining 10 m.); summit of Mt. Digitara, Wissel Lake region, *Eyma 5365* (♂, A, BO), Oct. 1939.

55. *Macaranga haplostachya* Pax & K. Hoffmann in *Pflanzenr.* 68 (IV. 147. XIV): 25. 1919.

Shrub or tree 4–12 m. tall, with slender, glabrous, granulo-glandular branchlets; stipules small, subulate, 3–4 mm. long, caducous; petiole 1–3 cm. long, glabrous; leaf-blades chartaceous, lanceolate, obtusely cuspidate-acuminate, 7–13 cm. long, 2–4.5 cm. broad, attenuate towards the base, the base very narrowly and shallowly cordate, very shortly repand-crenulate, pinnately veined, glabrous, biglandular on the upper surface at base, impressed granulo-glandular beneath, the primary veins 8–11 pairs; ♂ inflorescence simple, solitary, 2–5 cm. long, short-puberulous, glomerules many-flowered; bracts subtending the glomerules ovate-triangular, acuminate, entire, 2 mm. long, not patelliform-glandular within; flowers pale yellow or almost white, 3.5 mm. broad, on pedicels 2 mm. long; sepals 3, obovate, acute, outside puberulous and granulo-glandular, firm; stamens 15–17 with 4-locular anthers; ♀ flowers and fruit unknown.

Two collections are cited in the original description, *Ledermann* 8912 and 9020, alt. 850 m., Etappen Mountain, Northeast New Guinea. I have seen nothing which appears to match this description.

56. *Macaranga lanceolata* Pax & K. Hoffmann in Pflanzenr. 68 (IV. 147. XIV): 25. 1919.

Tree 15–20 m. high; young parts sparsely pilose but very quickly glabrate; stipules linear-lanceolate, stiffish, 2–3 mm. long, caducous; petioles 1–4 cm. long, slender; leaf-blades entire, chartaceous, 7–12 cm. long, 2–4 cm. broad, lanceolate, cuspidate-acuminate, at base suddenly contracted to about 2–2.5 mm. broad and extended downward to join the petiole, on the upper surface of this narrowed part bearing 2–4 shallow glands, pinnately veined with 6–9 pairs of inconspicuous primary veins, glabrous above, \pm granulo-glandular beneath; δ panicle sparsely pilose, 3–5 cm. long, fascicled, branched from the base, rachis slender, glomerules many-flowered; bracts subtending the glomerules triangular, acute, 1 mm. long, not patelliform-glandular within; sepals 3, about 1 mm. long, pilose outside and granulo-glandular; stamens 5–8 with 4-locular anthers; η panicle with branching and bracts similar to δ ; η calyx 3-lobed; ovary 1-locular, densely granulo-glandular, the style 1–3 mm. long, lateral and papillose; capsule globose, smooth, about 3 mm. diameter, borne on a pedicel up to 5 mm. long.

Eight collections are cited by Pax & K. Hoffmann, all brought out from Northeast New Guinea by Ledermann from an altitude of 850–1000 m. I have seen a few leaves; they are very scantily granulo-glandular beneath, and the unusual character noted is the very narrow short base to which the petiole is joined. I have seen no material like these leaves in the collections at hand.

57. *Macaranga kostermansii* sp. nov.

Arbor 6 m. alta; ramulis gracilibus, breviter pilosis et granuloso-glandulosis; stipulis oblongis, 2–3 mm. longis, obtusiusculis, glabris vel costa pilosa; petiolo 2–10 mm. longo; laminis (1.5–) 2.5–4.5 cm. longis, (0.5–) 0.9–1.3 cm. latis, obovato-oblongis apice obtusis, basi obtuse cuneatis, supra glabris et prope basin maculari-2–4-glandulosis, subtus dense granuloso-glandulosis et glabris, novellis costa breviter pilosis, peninerviis, venis primariis 5–7 paribus patentibus deinde prope marginem adscendentibus et anastomosantibus, rete irregulari et inconspicuo; inflorescentiis δ tantum visis, 1–3 cm. longis, dense granuloso-glandulosis, simplicibus vel sparsim ramosis, axi puberulo; bracteis florigeris non patelliformi-glandulosis, parvis, ovatis, acutis, 1 mm. longis; calyce 3-lobato, 1–1.3 mm. longo; staminibus 5–9, antheris 4-locularibus.

NETHERLANDS NEW GUINEA: Angi Gita lake, Vogelkop, alt. 1800 m., *Kostermans* 2099 (δ , A, TYPE), Oct. 1948 (tree 6 m. high; flowers greenish).

No other species of *Macaranga* from Malaysia in our herbarium has leaves as small as those found in this species. The characters may be

summarized as follows: very small leaves; short and simple or one- or two-branched ♂ inflorescences with densely granulo-glandular flowers closely crowded in glomerules along the axis; calyx three-lobed to the middle; five to nine stamens with four-locular anthers.

58. *Macaranga inermis* Pax & K. Hoffmann in Pflanzenr. 63 (IV. 147. VII): 333. 1914.

Tree with young growth densely fulvous-tomentose but very soon glabrate; branchlets angled; stipules falling very quickly, 5 mm. long, ovate, acute, tomentulose on the outer surface; petioles 4–8 cm. long, glabrous; leaf-blades coriaceous, entire, ovate or elliptic, acute or short-acuminate, 12–16 cm. long, 7–8 cm. broad, obtuse at the base and bearing 2–4 spot-like glands on the upper surface adjacent to the attachment of the petiole, glabrous above, beneath densely granulo-glandular and glabrous or with a slight pubescence remaining along the midrib, pinnately veined with 9–12 pairs of prominent primary veins, the secondary veins distinct; ♂ inflorescence unknown; ♀ panicle tomentulose, 4–7 cm. long, with spreading branches; bracts 3–5 mm. long, triangular, acute, not patelliform-glandular within, each bract often subtending 2 flowers; pedicels up to 3.5 mm. long in fruit; ovary 1-locular, tomentulose and granulo-glandular, smooth, the style lateral, plumose; capsule subglobose, tomentulose.

NORTHEAST NEW GUINEA: forest of Kani Mountain, alt. 1000 m., Schlechter 17740 (♀, A), May 1908.

Schlechter's specimen represents one of two numbers cited in the original description. Unfortunately the growing tips of both branchlets have been broken off so that I have not seen the stipules. Although I can match the leaves and the tomentulose axis and pedicels of the inflorescence with those of other collections, in the latter none of the capsules is so tomentulose as those on this specimen, in fact most of them are glabrous. It has not been an easy task to try to determine the abundant related collections at hand. Four closely related species have been described from New Guinea: *M. inermis*, *M. effusa*, *M. penninervia*, and *M. mallotiformis*. I have only a couple of carbon rubbings from leaves of *M. mallotiformis*, and one rubbing from a leaf of *M. effusa*, to represent these species. At present I am unable to accept them as distinct species, and the key to the § *Inermes*, Pflanzenr. 68 (IV. 147. XIV): 25, is inadequate for separating the species therein indicated.

58A. *Macaranga inermis* var. *mallotiformis* (Pax & K. Hoffmann) comb. nov.

Macaranga mallotiformis Pax & K. Hoffmann in Pflanzenr. 68 (IV. 147. XIV): 27. 1919.

Shrub or tree with pubescent new growth; stipules lanceolate or ovate-lanceolate, 3–8 mm. long, caducous or subpersistent; leaf-blades 6–15 cm. long, 2.5–8 cm. broad, pilose on the veins beneath or glabrous, densely

granulo-glandular; ♂ panicle puberulous or sometimes almost glabrous, branching from near the base; bracts subtending the glomerules triangular, acute, hardly 1 mm. long, not patelliform-glandular within; calyx about 1 mm. long, 3-lobed; stamens 5–8 with 4-locular anthers; ♀ panicle puberulous; calyx 3-lobed and persistent; capsule 1-locular, smooth, somewhat oblique, densely granulo-glandular, glabrous, about 2 mm. diameter, the style plumose, quickly falling.

NETHERLANDS NEW GUINEA: occasional in rain forest, 15 km. SW of Bernhard Camp, Idenburg River, alt. 1750 m., *Brass & Versteegh 11933* (♀, A), Jan. 1939 (tree 21 m. high with white flowers; fruit yellow-brown); common in mossy forest seral growths, same locality, alt. 1800 m., *Brass 12062* (♀, A), Jan. 1939 (tree attaining 12 m.; bark a conspicuous pale gray; leaf-margins recurved at base); open place in mossy forest, same locality, *Brass 12145* (♂, A), Jan. 1939 (tree 2.5 m. high); frequent in primary forest, Bele River, 18 km. NE of Lake Habbema, alt. about 2270 m., *Brass & Versteegh 11122* (♀, A), Nov. 1938 (tree 25 m. high, 43 cm. diameter; bark gray, smooth; wood rose).

PAPUA: forest, Boridi, alt. 1500 m., *Carr 13153* (♂, A, BM), Sept. 1935 (tree 100 ft. tall); same locality, *Carr 13187* (♀, BM), Sept. 1935 (tree 80 ft.); same locality, *Carr 13328* (♂, A, BM), *13387* (♂, A, BM); same locality, alt. about 1400 m., *Carr 14446* (♀, BM), Oct. 1935 (tree 50 ft.); same locality, *Carr 14468* (♂, A, BM); same locality, alt. about 1500 m., *Carr 14562* (♂, BM), Oct. 1935 (tree about 50 ft. tall; flowers cream suffused red); same locality, alt. about 1650 m., *Carr 14603* (♀, A, BM); same locality, alt. about 1350 m., *Carr 14773* (♀, A, BM), Nov. 1935 (tree about 25 ft. tall; flowers and fruit green); Alola, alt. about 1950 m., *Carr 13735* (♂, A, BM), Dec. 1935 (tree about 100 ft. tall).

NORTHEAST NEW GUINEA: Black Cat—Bitoi, alt. about 1340 m., *McAdam 401* (♀, BR, LAE), Apr. 1939 (small tree 29/54/81 with small spurs, fluted to 10 ft., and trunk in wavy bends above 20 ft.; crown small and compact; bark reddish brown; blaze a green line lightening inward to cream, then red for major portion); Ogeramnang, alt. 1770–1800 m., *Clemens 4466* (♀, A), Dec. 1936; Sambanga, alt. 1500–1800 m., *Clemens 6955A* (♀, A), Sept. 1937; same locality, *Clemens 7604* (♀, A), Nov. 1937.

Most of the specimens cited above have glabrous mature leaves, but in *Brass 12062* and *12145* a few hairs may be found on the lower surface along the veins. Apart from the glabrous character most of these specimens fall within the range of the description of *M. mallotiformis* Pax & K. Hoffm. A few in the large series from Boridi show a transition in the size of the leaves to those of the isotype of *M. inermis*, and these, with the instability of the pubescence character, have brought me to believe that the differences are only of a varietal nature. An opportunity to examine the cited collections of *M. mallotiformis* and more material of *M. inermis* might reveal other differences which are specific.

58B. *Macaranga inermis* var. *penninervia* (Pax & K. Hoffmann)
comb. nov.

Macaranga penninervia Pax & K. Hoffmann in Pflanzenr. 68 (IV. 147. XIV): 26. 1919.

? *Macaranga effusa* Pax & K. Hoffmann in Pflanzenr. 68 (IV. 147. XIV): 26. 1919.

Glabrous tree; stipules subpersistent, about 8 mm. long, concave, acute; petioles 5–8 cm. long; leaf-blades coriaceous and entire, elliptic, 12–17 cm. long, 6.5–11 cm. broad, short-acuminate, acute at the base and bearing 2 flat glands on the upper surface near the attachment of the petiole, densely granulo-glandular beneath, pinnately veined and net-veined, the primary veins 10–12 pairs; ♂ panicle 5–7 cm. long, divaricately branched, granulo-glandular; bracts subtending the glomerules triangular-ovate, concave, 2 mm. long, not patelliform-glandular within; calyx 3-lobed; stamens 5–8 with 4-locular (very rarely 3-locular) anthers; ♀ panicle similar to ♂; calyx 3-dentate; capsule 2–3 mm. diameter, densely granulo-glandular, smooth.

NETHERLANDS NEW GUINEA: Barara, Wissel Lake region, *Eyma* 5168 (♂, A, BO), 5169 (♀, A, BO), Sept. 1939.

The specimens cited here are very densely granulo-glandular on the lower surface of the leaves and on the inflorescence; the upper surface of the leaves is also granulo-glandular or minutely punctate, a feature characteristic of young leaves, but usually not persisting.

Macaranga effusa Pax & K. Hoffm. has been placed in the synonymy with a query. Without authentic material to examine, it seems to me to be only a vigorous growth of this variety with which it is placed. Possibly I have overlooked some significant character in the description. It is true that the ♂ flowers are described as having nine to twelve stamens, and I have seen none in the varieties with more than eight; however, in a genus where the number of stamens is variable, the variation between eight and nine cannot be considered distinguishing.

58C. *Macaranga inermis* var. *plurifoveata* var. nov.

A forma typica differt laminis 9–18 cm. longis, 5.5–11.5 cm. latis, basi supra 3–8-foveatis, venis primariis 10–14 paribus; ♂ paniculis 5–8 cm. longis, bracteis triangularibus 1 mm. longis, non patellari-glandulosis; calyce 3-lobato, puberulo, granuloso-glanduloso, staminibus 5–7, antheris 4-locularibus; capsula 1-loculari, granuloso-glandulosa, parce puberulo-tomentulosa.

NETHERLANDS NEW GUINEA: occasional in primary forest, 6 km. SW of Bernhard Camp, Idenburg River, alt. 1230 m., *Brass & Versteegh* 12591 (♂, A, TYPE), Feb. 1939 (tree 24 m. high, 56 cm. diameter; bark black; wood red; flowers gray); occasional in primary forest, 15 km. SW of Bernhard Camp, Idenburg River, alt. 1480 m., *Brass & Versteegh* 11979 (♀, A), Jan. 1939 (tree 29 m. high, 40 cm. diameter; bark black; wood red-brown; fruit brown); Angi, Arfak Mts., in the forest by Iray, Lake Giji, alt. 1900 m., *Kanehira & Hatusima* 13750 (♂, A, BO), April 1940 (tree 10 m.); Angi Gita

Lake, Arfak, alt. 1800 m., *Kostermans* 2328 (♀, A, BO), Oct. 1948 (tree 5 m. high).

This variety differs from the other material of this alliance chiefly in the pit-like glands on the upper surface around the attachment of the petiole.

59. *Macaranga pleiostemona* Pax & K. Hoffmann in Pflanzenr. 68 (IV. 147. XIV): 24. 1919.

Glabrous tree to 15 m. tall with branchlets often drying striate; the linear-subulate stipules 4 or 5 mm. long and caducous; petioles 1–2.5 cm. long; leaf-blades linear-lanceolate, acuminate or acute, 11–20 cm. long, 2–4 cm. broad, narrowed towards the minutely cordate or truncate base, on the upper surface adjacent to the petiole attachment bearing 2 oblong flat glands and here the margin recurved, beneath very densely granulo-glandular, strongly feather-veined with 12–20 pairs of primary veins spreading-ascending and arcuate near the denticulate margin; ♂ panicle granulo-glandular, 3–6 cm. long with a few short branches; the triangular bracts subtending the glomerules about 1.3 mm. long, 1.5 mm. broad, not patelliform-glandular within; the acutish ♂ bud 2 mm. high and almost as broad; stamens 38–53 with 4-locular anthers; ♀ panicle 4 cm. long and few-branched; pedicels 1–2 mm. long in the flower to 4 mm. long in the fruit, subtended by a small triangular bract; the 1.5 mm. long calyx deeply 3-lobed (lobes about 1 mm.); ovary 1-locular and densely granulo-glandular with 1–5 short processes (0.5 mm. long) near the apex, the style lateral, about 3 mm. long and densely papillose; capsule very small, 2.5 mm. diameter with usually 1 or 2 processes or none, the seed 2 mm. diameter, minutely rugulose.

NETHERLANDS NEW GUINEA: Prauw bivouac, Tigmeerlake — Enarotali, Lake Tigi, alt. 1650–1750 m., *Eyma* 4884 (♂, A, BO); brushy seral growths on old stone wash, Balim River, alt. 1600 m., *Brass* 11663 (♀, A), 11664 (♂, A), Dec. 1938 (tree 2 m. high).

NORTHEAST NEW GUINEA: open woods, Wantoat (Wantot), alt. about 1200 m., *Clemens* 40911A (♀, A), Feb. 1940; forest margin, Yunzaing, alt. about 1350 m., *Clemens* 3279 (♂, A), June 1936 (tree 5 inches diameter breast high; flowers white).

Superficially this species suggests a narrow-leaved form of *M. angustifolia* having the two oblong flat glands near the petiole attachment, a profusion of minute glands on the lower surface of the leaf, small fruits with one or two processes (or none); *M. pleiostemona* differs, however, in having rather numerous stamens and very inconspicuous bracts without patelliform glands on the upper surface, also the fruits are hardly fascicled, often two from a node but not usually three or four or more, as in *M. angustifolia*. In the Clemens collections the leaves are more nearly acute than acuminate.

59A. *Macaranga pleiostemona* f. *pubescens* forma nov.

A forma typica differt partibus juvenilibus etiam axibus et bracteis inflorescentiae, pedicellis et calycibus minute pubescentibus.

PAPUA: forest, Boridi, alt. about 1500 m., *Carr 14588* (♂, A, BM), Oct. 1935 (tree about 17 ft. tall); open country, Boridi, alt. about 1200 m., *Carr 14837* (♂, A, BM), Nov. 1935 (tree about 15 ft. tall); secondary forest, Isuarava, alt. about 1350 m., *Carr 15347* (♂, A, TYPE; BM), *15348* (♀, A, BM), Feb. 1936 (tree about 10 ft. tall).

These collections differ from those cited for the species in having pubescent new growth and pubescent inflorescences. While this is not a heavy pubescence (it might be called a puberulence), it is particularly noticeable around the axils of the bracts. Sometimes a few hairs occur on the ovary, but these quickly disappear. I searched the fruits of this form carefully for processes before finding three with one process each; in the typical species a fruit usually has one process. It should be pointed out that there is considerable variation in the number of stamens also, in five flowers counted I found 32, 38, 45, 46, and 59 stamens respectively.

DOUBTFUL SPECIES

***Macaranga brunneo-floccosa* Pax & K. Hoffmann in Pflanzenr. 68 (IV. 147. XIV): 28. 1919.**

Macaranga brunneo-floccosa var. *β calvescens* Pax & K. Hoffmann l. c.

Tree 10–12 m. tall with densely ferrugineous floccose tomentum on the branchlets, petioles, stipules, and young leaves, tardily glabrate; stipules lance-oblong, 2 mm. long, caducous; leaf-blades entire, coriaceous, rhombic-ovate or broadly elliptic, 7–15 cm. long, 3.5–10 cm. broad, shortly and abruptly acuminate, obtuse or rounded at the base, not glandular on either surface, on maturing glabrous above except for the pubescent veins, the tomentum appearing here and there in small patches on the under surface, probably finally glabrous, 3-nerved at the base with 3–5 pairs of primary veins above the basal ones, the secondary venation distinct on the lower surface; ♂ panicles about 4 cm. long, irregularly branched, densely hairy with very fine crisped hairs and sparsely granulo-glandular; bracts subtending the glomerules ovate, 1.5 mm. long, not patelliform-glandular; sepals 3, concave, crisply hairy; stamens \pm 10 with 4-locular anthers; ♀ inflorescence unknown.

There are in our herbarium the following collections from Netherlands New Guinea, characterized by floccose tomentum, and the lack of granular glands on the leaves: *Brass & Versteegh 13163* (♀); *Brass 12711* (♂); *Kostermans 2232* (♂) and *2292* (♂); and *Kanehira & Hatusima 13470* (♂). The leaves of *Brass & Versteegh* correspond in size and glabrescence to those in the description of *M. brunneo-floccosa*, var. *β calvescens*. The capsule appears to be four-lobed but when dissected there are only two locules with one ovule in each, but the locules are densely hairy inside, a

character not observed in the other species of *Macaranga*. So far as the ♂ material is concerned, I see no reason for excluding it from *Macaranga*; but my lack of knowledge of the other genera of this large and diverse family has led me to place this as a doubtful species.

Another collection, *Brass 5052*, with large peltate leaves and villous-tomentose pubescence has all the characters of *Macaranga*, as far as I can judge from the specimen at hand, excepting the dense coat of longish hairs inside the locules of the capsules.

In addition to the above I have at hand several collections of unnamed *Macaranga*, some of which may possibly be new but are not sufficiently distinctive to describe or comment on without supplementary material.

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STUDIES IN THE BORAGINACEAE, XXV A REVALUATION OF SOME GENERA OF THE LITHOSPERMEAE

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AS A BACKGROUND for a study of *Lithospermum* and its immediate relatives it has been necessary to investigate and determine the characters of some of the other genera included in the Lithospermeae. It has been surprising to discover that most of these latter genera have a variety of interesting features that have gone unmentioned in published accounts of them. So much of interest was found that it has seemed desirable to prepare new and more complete descriptions of these genera and also to discuss their characters and relations. Six genera, all confined to the Old World, are so treated in the present paper.

The general affinities of the genera treated are well indicated by their pollen morphology. *Lithodora* appears to be a highly specialized derivative of the *Lithospermum*-complex, notable chiefly for its frutescent habit and aberrant nutlets. Its pollen has eight pores and a form duplicated also in *Lithospermum* and its close allies. The remaining five genera discussed appear to be more closely related to one another than to *Lithospermum* or its close allies. Except in one section of *Moltkia* their pollen is 3-pored and hence of a type different from that in *Lithospermum* and its immediate allies. As a group the five genera are also notable for the frequent development of bent nutlets and for the recurring manifestations of bilateral symmetry in their corolla and androecium.

The six genera discussed may be distinguished by the following key:

- Nutlets circumscissile above the base, their major seminiferous portion falling away, leaving the true base persisting as a usually cupulate appendage permanently affixed to the gynobase; corolla without annulus or appendages; pollen ellipsoidal or somewhat ovoid, pores usually 8, borne at or slightly below the middle of the grain; body of nutlet straight. 1. *Lithodora*.
- Nutlets detaching completely from the gynobase.
 - Corolla without annulus; stamens all affixed at the same height on the corolla; pollen globose or globose-ellipsoid, pores 3-8, equatorial; body of nutlet somewhat bent.
 - Corolla without appendages; lobes short, broadly imbricate in the bud, becoming erect; style exerted only after the corolla is fully developed; anthers not ciliate; pollen with 3-8 pores. 2. *Moltkia*.
 - Corolla with squamate appendages between the base of the filaments; corolla-lobes elongate, very narrowly imbricate in the bud; style precociously exerted, protruding from the incompletely developed corolla; anthers having the margins of the theca ciliate with crowded stout hairs; pollen with 3 pores. 3. *Halacsya*.

Corolla with annulus developed; stamens usually affixed at unequal heights on the corolla; pollen usually conic-ovoid with the sides straight and convergent above the broad rounded base, pores 3, borne above base of the grain.

Nutlets very strongly and conspicuously bent, attachment small and substipitate; stamens deeply included, never exerted from the corolla, sometimes all affixed at the same height on the corolla but usually with the 2 adaxial ones affixed lower than the other 3; filaments very short; anthers with a narrow connective to which the filament is directly affixed, lacking a pit in the connective; corolla usually with appendages at the base of the deep throat or near the middle of the tube, these appendages alternating with the stamens and borne near or somewhat above the level of the filament-attachments; corolla usually glanduliferous inside; style deeply included, usually less than half the length of the corolla. 4. *Alkanna*.

Nutlets straight or rarely weakly bent, attachment sessile and usually broad; stamens some or all usually exerted from the corolla-throat, sometimes affixed at the same altitude on the corolla but usually with the 2 adaxial members highest or the abaxial one lowest on the corolla; filaments usually very elongate; filaments affixed to the anthers in the depths of a pit located near the middle of the relatively broad connective; corolla without any appendages alternating with the stamens and never glanduliferous inside; style usually elongated and usually exerted at least beyond the throat of the corolla.

Annulus composed of a minute collar or of a ring of 5-10 minute sparingly hairy lobes, borne very close to (less than 1 mm. above) the corolla-base; style almost always 2-lobed; corolla facing backwards over the curved top of the cyme and more or less distinctly resupinate. 5. *Echium*.

Annulus developed well above (1.5-6 mm. above) the corolla base and represented by 5 evident, densely villous swellings or 5 squamose appendages borne one below the attachment of each stamen; style always simple; corolla usually erect, rarely resupinate; South Africa. 6. *Lobostemon*.

1. *Lithodora* Griseb. Spicileg. Fl. Rumel. 2: 85 (1844); Reichenb. Icon. Fl. Germ. 18: 66, t. 1315 (1858); Johnston, Contr. Gray Herb. 73: 55 (1924); G. Stroh, Beih. Bot. Centralbl. 58^B: 211 (1938). Type species *L. fruticosum* L.

Lithospermum § *Lithodora* Boiss. Fl. Orient. 4: 219 (1879).

Plant perennial, fruticose. Leaves veinless or nearly so. Cymes small, lax, 1-10-flowered, not scorpioid. Calyx 5-parted, lobes narrow, subequal, slightly accrescent at maturity. Flowers heterostylic or monomorphic. Corolla blue or purple, funnellform, with a cylindric tube and a short ob-

conic throat, outside glabrous or hairy; lobes ascending or spreading, rounded ovate or suborbicular, imbricate in the bud; throat without appendages, glabrous or bearing stipitate glands or sometimes villose; tube glabrous inside, lacking a basal annulus¹ or vestiges of it. Stamens affixed low in the throat and all borne at the same level, or the stamens affixed at unequal heights in the throat of the individual corolla. Filaments filiform, much shorter than the anthers or nearly as long or even longer, in heterostylic species short filaments associated with long-styled flowers and long filaments with short-styled ones, in species having stamens borne at unequal heights on the throat the lower stamen usually with the shortest filament. Anther oblong, usually several times longer than broad, affixed medially or slightly submedially, included or slightly exerted only in some short-styled flowers, base emarginate, apex obtuse or retuse, thecae usually united almost to the base but in one species these more or less separate below their middle. Style filiform and frequently somewhat laterally compressed, usually either shorter than the calyx or about twice as long, simple or somewhat forked at the summit, included or shortly exerted from the throat; stigmas 2, terminal and juxtaposed on the tip of the simple style or one terminating each of the short stout lobes of the apically forked style. Pollen small, $18-25 \times 15-23 \mu$, ellipsoidal or somewhat ovoid; pores usually 8, borne in a single row around the grain at or slightly below the equator. Nutlets straight, ovoid or ovoid-cylindric, commonly only one maturing, smooth or very abundantly and minutely muriculate, tuberculate or rugulose, with a prominent ventral keel (ventral suture fused, obscure), at maturity developing a circumscissile abscission above the base, the major seminiferous portion of the nutlet detaching and falling away, leaving the short sterile basal section to form a usually cupulate appendage permanently affixed to the low pyramidal gynobase; attachment scar of detached nutlets basal, horizontal, or slightly oblique, nearly as broad as long, bearing a projecting indurate appendage; appendage usually peg-like and nearly central but in one species angulate, somewhat pyramidal, and occupying most of the dorsal half of the scar.

The genus *Lithodora* has been recognized by few authors. Its species have been almost universally assigned to *Lithospermum*, and because of general similarities in fruticose habit even associated with species referable

¹ The term **annulus** is applied to the usually minute appendages borne inside the corolla-tube usually just above its very base. Though in some species and genera it is never developed, in most Boraginoideae it is usually represented either by a tumid ring, a narrow annular ridge, or a collar-like structure, or, perhaps more commonly, by a ring of 5-10 small equidistant lobes borne just above the corolla-base. When present the annulus is usually appressed against the base of the ovary and apparently functions in limiting access to the nectary beneath the ovary. Only in a few genera, such as *Onosma*, are the lobes of the annulus themselves apparently nectariferous. Because of this it seems desirable to substitute the appellation *annulus* for "tube-nectary," which I have used in several previous papers of this series. The annulus is a structure that has been generally ignored by students of the Boraginaceae, although its usefulness in classification was long ago indicated by Bunge, *Heliocarya* 10-11 (1871). For some recent notes on its function see H. Schaefer, *Bot. Jahrb.* 72: 319 (1942).

to *Moltkia* and *Buglossoides*. As a matter of fact the genus is probably not very closely related to the genera mentioned. Actually it is one of the very distinct members of the *Lithospermeae*. It has nutlets of a type that is unique in the whole Boraginaceae. Only in a group of plants that has had no over-all critical re-examination for over a hundred years, such as the *Lithospermeae*, could the unusual features of this genus have gone so long unrecognized.

The species of *Lithodora* are low shrubs which frequent cliffs and other exposed rocky places. One species ranges in western France (north to Brittany) and in western portions of the Iberian peninsula and Morocco. The six other congeners occur in restricted areas scattered in the Mediterranean region as far east as coastal Anatolia.

The distinctive features of the fruits of *Lithodora* are all associated with the fact that the nutlets are freed from the gynobase not by a basal, but a suprabasal abscission. In all *Boraginoideae* other than *Lithodora* the abscission is developed at the very base of the nutlet at the level where the latter becomes differentiated from the gynobase. In such genera as *Lithospermum*, which may agree with *Lithodora* in having erect basally affixed nutlets, the abscission, usually plane, is exactly basal, and as a result the complete nutlet is freed from the gynobase. In *Lithodora*, however, a basal section of the nutlet never becomes detached from the gynobase. The abscission freeing the major seminiferous portion of the nutlet develops not at the morphological base of the nutlet but distinctly (0.5–1 mm.) above it. As a result, when the fertile upper section of the nutlet detaches, a short basal section of it remains as a persisting saucer-shaped or cup-shaped appendage on the gynobase. The condition is unique. It distinguishes *Lithodora* from all other genera of the Boraginaceae.

Since the attachment end of the freed nutlets is not the morphological base of the nutlet, it is not surprising that its attachment scar should have peculiarities. The scar may be horizontal or slightly oblique but is never plane, as is prevalent with the nutlets of genera related to *Lithospermum*. In six of the seven species of *Lithodora*, the attachment surface bears near its center a vertical peg-like appendage 1–2 mm. long. This appendage is composed of indurate tissue that surrounds the tubular canal through which the ovule was formerly supplied by a vascular strand arising from the gynobase. On the detached nutlets of *L. rosmarinifolia*, *L. moroccana*, *L. oleaeifolia* and *L. diffusa*, the canal within the appendage is usually empty. The section of the funicular strand which formerly occupied it remains attached to the basal section of the nutlet, and like a bristle arises from the center of that cup-like structure. In *L. fruticosa* the base of the detached nutlet has different features. The dorsal half of the base is occupied by a solid, irregular, somewhat pyramidal mass of salient indurate tissue. An angular excavation may occupy most of the ventral half of the base. The projecting rough pyramidal mass contains two embedded vascular strands but no tubular canal. This appendage on the detached nutlets of *L. fruticosa* not only has a more dorsal position on the base, it has a structure that is different from the peg-like appendage on the nutlets of the

other species of the genus. In the latter the appendage is made up of hardly more than the bony walls of the funicular canal. In *L. fruticosa* the funicular canal is not included in the appendage. The canal for the funicle has a course paralleling and just inside the ventral keel of the nutlet and continues so downward to just below the abscission. In the portion of the nutlet remaining affixed to the gynobase, its lower course is apparently marked by a ridge sloping downward and inward towards the middle of the cup-like structure. The canal remains close to the ventral wall of the nutlet and joined to it.

The prominences on the base of the detached nutlets of *Lithodora* have a superficial similarity to the strophiolate outgrowths on the attachment surface of the nutlets of the *Anchuseae*. They are, however, morphologically very different structures. The nutlets of the *Anchuseae* detach completely from the gynobase. Their prominent, rounded, plug-like attachment surface is oily and parenchymatous (an elaiosome) and is seated in a socket in the gynobase, cf. Bacin. Bul. Fac. de Științe, Cernăuți 9: 123-169 (1935). The prominences on the attachment scar of nutlets in *Lithodora* are bony tissue formerly filling a basal section of the nutlet that never becomes freed from the gynobase.

The androecium of *Lithodora* shows considerable diversity and presents some unusual developments. Heterostyly is well developed in five of the seven species. In flowers with long styles the stamens are borne low in the corolla-throat on filaments much shorter than the anthers (usually about a quarter as long) while in short-styled flowers the stamens are borne slightly higher in the throat on filaments equaling or even slightly longer than the anthers. The dimorphism here involves not merely differences in style length and the height at which stamens are affixed in the throat, but also length of filaments. Among the Boraginaceae I know of only one other example with this particular type of dimorphism, viz., *Lithospermum hispidissimum*, cf. Jour. Arnold Arb. 33: 325 (1952). Unlike that species, however, the five members of *Lithodora* show no dimorphism in pollen. In *Lithodora* the pollen of long- and short-styled flowers is indistinguishable. Illustrations of the dissected corollas of *L. hispidula*, *L. oleaeifolia*, *L. Zahnii*, and *L. rosmarinifolia* are given by Spengler, Oesterr. Bot. Zeitschr. 68: 115, t. 1, f. 18, 20, 21 and 22 (1919), but by coincidence only the short-styled corollas of all these species were selected for illustration.

Lithodora fruticosa presents a very simple form of heterostyly. As in the species previously described, the flowers have either a short style, reaching about half way up the corolla-tube, or a long one which may equal the corolla-tube or become shortly exerted from it. In *L. fruticosa*, however, there is no concomitant dimorphism in the androecium. The stamens always have short filaments and are always borne in the same relative position low in the corolla-throat, cf. Spengler l.c., t. 1, f. 17. Heterostyly in this species appears to be reduced to its simplest expression, dimorphy of style only.

In *L. diffusa* the androecium deviates in organization from that in all other species of the genus. The flowers are not at all heterostylic. The

stamens are not equal nor verticillate. The five stamens within a flower differ in length of filament and in the altitude at which each is attached above the corolla-base. There are three uppermost stamens borne at nearly the same level. Below these there is a fourth stamen attached at middle height and below that a fifth, obviously affixed lowest down in the corolla-throat. The distance between the attachment points of the highest and lowest stamens may be 1.5–3 mm. Associated with the varying heights above the corolla-base at which the stamens are attached is also a variation in the length of the filaments. The higher the position of the stamen the longer its filament. The lowest stamen, accordingly, is distinguishable not merely by its low attachment but by the shortness of its filament as well. Its position on the corolla relative to the axis of the cyme (whether axial or abaxial) I have been unable to determine with certainty. The anthers in most species of *Lithodora* are elongate, usually several times as long as broad. In *L. diffusa* they are proportionately shorter, usually less than twice as long as broad, and instead of having merely emarginate bases usually tend to be distinctly lobed below their middle. Plants of *L. diffusa* have either a long style in the flower or a short one. From the collections examined I can find no evidence that individual plants differing only in style length grow together in one locality. Interestingly, all the plants seen from northern portions of the geographic range of the species have long styles only, whereas those from the south have only short styles. The indications are that in *L. diffusa* style length varies only as a character of geographic races.

The pollen of *Lithodora* is small, $18-25 \times 15-23 \mu$, and usually ellipsoidal or ovoid. It is circular in polar profile. The eight pores are inconspicuous and are arranged around the grain in a single row on the equator or slightly below it. None of the species of the genus have distinctive pollen, and there is no difference in the grains of long- and short-styled flowers of heterostylic species. In some species individual plants producing somewhat ovoid grains with submedial pores appear to be more common than those producing ellipsoidal grains with equatorial pores. In other species the reverse condition prevails. In varying degrees, however, the variation from ellipsoidal to ovoid is observable among individuals in all the species.

The bracted inflorescence is short, loose, and few-flowered, and not at all markedly differentiated from the leafy mass of the plant. It commonly bears three to seven flowers (rarely as many as ten), and even at maturity is not at all scorpioid.

When he established *Lithodora*, Grisebach gave a generic description and listed six species of *Lithospermum* referable to the proposed genus, viz., *Lithospermum fruticosum* L. ("cum forma brevistyla: *L. rosmarinifolium* Ten."), *L. hispidulum* Sm., *L. calabrum* Ten. (known only from description), *L. oleaefolium* Lois. (no flowers seen) and as "parum a ceteris aberrant," also *L. prostratum* Lois., and *L. graminifolium* Viv. Of the six species mentioned *L. calabrum* belongs to *Buglossoides* and *L. graminifolium* to *Moltkia*. Two species, *L. prostratum* and *L. graminifolium*,

Grisebach considered aberrant, for as he states, they have characters not in accord with his diagnosis of *Lithodora*. Grisebach knew *L. calabrum* only from the literature and had only incomplete specimens of *L. oleae-folium*. His concept of *Lithodora*, accordingly, must have been founded primarily upon *L. fruticosum* and *L. hispidulum*. Of these two the former is selected as type of the genus. It is to be noted that at the time he founded the genus *Lithodora*, Grisebach made no new binomials under that genus. He merely listed species of *Lithospermum* referable to it. Five new combinations (for all the species mentioned except *L. rosmarinifolium*) are, however, legitimately published in the index concluding the volume. The two volumes of Grisebach's "Spicilegium Florae rumelicae et bithynicae" were published in six fascicles issued over a period of three years. The description of *Lithodora*, vol. 2, p. 85, was included in Heft 5 (pp. 1-160) issued in mid-1844, cf. *Flora* 1844²: 526, Aug. 14, 1844. The index concluding volume 2 was included in the Double Heft, 5-6 (pp. 161-548) issued early in 1846, cf. *Flora* 1846: 96, Feb. 14, 1846, and *Bot. Zeit.* 4: 226, March 27, 1846. Although published in the same volume, Grisebach's genus bears the date 1844, whereas his binomials under that genus date from 1846.

Gymnoleima Decne. (1844) has been treated as a synonym of *Lithodora*, but I have typified it by *Lithospermum graminifolium* Viv. and placed it as a synonym of *Moltkia*.

Section *Allostema*, sect. nov.

Flores evidenter dimorphi. Stamina sub altitudinibus aequalibus inserta; eis in flores stylum longiorem gerente basim versus faucium orientibus, filamentis quam antheris brevioribus donatis; eis in flore stylum brevioris gerente supra medium faucium orientibus, filamentis antheris aequilongis vel longioribus donatis. Antherae elongatae basi emarginatae. Nuculae laeves vel (ea *L. hispidulae*) muriculatae cicatrice appendiculam erectam gracilem elongatam canale funiculari inclusam proferente donatae.

Lithodora rosmarinifolia (Ten.) Johnston, Contr. Gray Herb. 73: 56 (1924).

Lithospermum rosmarinifolium Ten. Fl. Neap. Prodr., Suppl. 2: 66 (1811-13) and Fl. Neap. 3: t. 114 (1811-15).

Known only from southern Italy, Sicily, and northeastern Algeria. Shrub to 6 dm. tall; stem and narrow elongate leaves strigose (hairs usually less than 1 mm. long, closely appressed, all antrorse); corolla evidently hairy outside, throat sparsely glanduliferous inside; calyx short, base becoming distinctly thickened and ribbed at maturity; nutlets smooth.

Lithodora moroccana, sp. nov.

Lithospermum diffusum var. *micranthum* Faure & Maire in Maire, Bull. Soc. d'Hist. Nat. Afr. du Nord 22: 56 (1931).

Known only from Morocco. Shrubby with prostrate stems, plant less than 1.5 dm. tall; stems and narrow elongate leaves clothed with slender loosely appressed hairs (0.8–2 mm. long) which are partly antrorse and partly retrorse; corolla evidently hairy outside, inside with sparsely glanduliferous throat; calyx short, the base becoming thickened and ribbed at maturity; nutlets smooth.

Frutex depressa 5–15 cm. alta cinerea; caulibus prostratis lignosis ramosis vetustiore decorticatis, ramulis foliatis 1–10 cm. longis erectis vel adscendentibus dense hispido-villosis pilos gracillimos rigidulos 1.5–2.5 mm. longos juventate adscendentes mox erectos deinde retrorsos gerentibus; foliis oblanceolatis 1–2.5 cm. longis 2–6 mm. latis margine saepe revolutis, facie superiore pilos gracillimos 0.8–2 (saepe ca. 1) mm. longos laxe antrorseque adpressos e basi bulbosa vel rariter discoidea orientes gerentibus, facie inferiore pilis albis abundantibus gracillimis laxe appressis alii antrorsis alii retrorsis gestis indumento denso albo laxe appresso praeditis; calyce 5–6 mm. longo tubo corollae conspicue brevior sessili maturitate basi evidenter incrassato, lobis cuneatis; corolla 15–18 mm. longa, extus pilis numerosis gracilibus antrorsis gesta, limba ca. 1 cm. diametro, lobis rotundis 3–3.5 mm. longis 2.5–3 mm. latis ascendentibus, faucibus inconspicue glanduliferis, tubo 12–16 mm. longo intus glabro; antheris elongatis 1.5–2 mm. longis; filamentis aequalibus, in floribus stylum longum gerentibus supra medium tubi corollae (6–9 mm. supra basim tubi) affixis brevis ca. 0.5 mm. longis, in floribus stylum longum gerentibus longioribus 1.5–2 mm. longis apice tubo corollae affixis; stylo 6–7 mm. longo et paulo supra medium tubi corollae attingente vel 12–17 mm. longo et tubo aequilongo vel longiore; nuculis erectis albis laevibus 2.7–3.7 mm. longis.

MOROCCO: env. de Debdou, rocaïles et rochers dominant le Camp Roumons, 100–1200 m., Apr. 4, 1928, *Briquet* 227 (G); Debdou, ad rupes supra Castra Roumens, ca. 1300 m., Apr. 10, 1928, *Wilczek & Dutoit* 294 (Kew); Monte Bu-Ibdiren (Beni-bu-Yahi), coteaux calcaïres, Jan. 23, 1931, *Mauricio* 7946 (G); Monte Bu-Ibdiren, Apr. 22, 1934, *Mauricio & Sennen* 7946 (TYPE, Brit. Museum); Beni Snassen, Taforalt, broussailles du Djebel Metchick, 1050 m., 1930, *A. Faure* (G); above Xauen in El Rif, 4500–5500 ft., limestone, April 14, 1939, *Peter Davis* 462 and 468 (Kew).

Although confused with *L. diffusa*, this plant is actually very much more closely related to *L. rosmarinifolia*. From the latter it differs in its depressed habit and its indument of much longer, more loosely appressed hairs. In *L. rosmarinifolia* the indument is distinctly strigose, the hairs being much shorter than those of *L. moroccana* and very much more closely appressed. Furthermore they are always antrorse. In the short-styled flowers of *L. moroccana* the filament and anthers are about equal in length. In comparable flowers of *L. rosmarinifolia* the filaments are longer than the anthers.

Lithodora oleaefolia (Lapeyr.) Griseb. Spicileg. Fl. Rumel. 2: 531 (1846).

Lithospermum oleaefolium Lapeyr. Hist. Abr. Pl. Pyr., Suppl. 28 (1813); Stapf, Bot. Mag. 149: t. 8994 (1924).

Local in the eastern Pyrenees. Plant shrubby, with slender, loosely decumbent stems; larger leaves 7–13 mm. broad, margins obscurely if at all revolute, lower surface with a dense white indument of abundant slender appressed hairs; corolla evidently hairy outside, inside with the throat sparingly glanduliferous; calyx at maturity divided into slender elongate lobes, base not thickened; nutlets smooth and shiny.

Lithodora Zahnii (Heldr.) Johnston, Contr. Gray Herb. 73: 56 (1924).

Lithospermum Zahnii Heldr. in Halacsy, Verh. Zool.-Bot. Ges. Wien 49: 190 (1899).

Lithospermum fruticosum sensu Sibth. & Sm. Fl. Graecae 11: 52, t. 161 (1813).

Mountains of Greece. Low shrub becoming 4 dm. tall, branches ascending and more or less regularly dichotomous. Leaves *Lavendula*-like, narrow, elongate and strongly revolute, 2–4 cm. long; corolla glabrous inside and out, throat not glanduliferous; calyx divided at maturity, the lobes not rigid, 8–11 mm. long, base not thickened; nutlets smooth, lustrous.

In this species the cupulate base of the nutlet, remaining joined to the gynobase, is well developed, commonly 1 mm. high. In *L. rosmarinifolia*, *L. moroccana*, *L. oleaefolia*, and *L. diffusa* a section of the funicular strand normally remains affixed in the depth of the persisting cup and arises bristle-like from within it. This section of strand is that formerly occupying the tubular canal in the appendage on the lower end of the detached nutlet. In *L. Zahnii* the strand remains within the canal of the detached nutlet, and there is, accordingly, no bristle-like section of it arising inside of the cupule.

Lithodora hispidula (Sibth. & Sm.) Griseb. Spicileg. Fl. Rumel. 2: 531 (1846).

Lithospermum hispidulum Sibth. & Sm. Prodr. Fl. Graecae 1: 114 (1806) and Fl. Graec. 2: 53, t. 162 (1813).

A low, twiggy, stiffly much branched shrub 1–3 dm. tall, restricted to islands and coastal regions of the eastern Mediterranean (Crete to south-west Turkey). Corolla glabrous inside and out, throat not glanduliferous; leaves small, spathulate to oblanceolate, less than 15 mm. long, usually ciliate with stout pungent hairs; calyx at maturity with a thick base and a short but distinct tube 1.5–2 mm. long; lobes rigid, 5–6 mm. long; nutlets dull, abundantly and minutely muriculate.

The most mature fruiting structures seen of this species are some with practically mature nutlets still firmly affixed. In these the basal section of the nutlet (that affixed to the gynobase), unlike that in other species of the genus, is longer than thick, and short-cylindric rather than cupulate in form. In collections of other species with a little search one can usually find some old calyces still persisting on the plant after the nutlets have

been matured and freed. In such old calyces the persisting base of the nutlet is studied to best advantage. Although eight collections of *L. hispidula* have been examined, in none of them have old calyces been found persisting.

Section *Eulithodora*.

Flowers not truly heterostylic; style long or short, but the stamens (all borne at the same level) constant as to position on the corolla and as to length of filaments. Corolla glabrous or with some hairs on the outer surface of the lobes; throat glabrous, not glanduliferous. Nutlets minutely and longitudinally striate, strongly constricted just above the base, attachment scar bearing a somewhat pyramidal angulate projection.

Lithodora fruticosa (L.) Griseb. Spicileg. Fl. Rumel. 2: 531 (1846).

Lithospermum fruticosum L. Sp. Pl. 133 (1753).

Lithospermum consobrinum Pomel, Nouv. Mat. Fl. Atlant. 296 (1874).

Lithodora consobrina (Pomel) Johnston, Contr. Gray Herb. 73: 56 (1924).

A species native to southeastern (Mediterranean) France, middle and eastern Spain, and the coast of Algeria. In vegetative condition sometimes confused with the very different *L. diffusa*, but readily distinguished by having short, more closely appressed hairs on the herbage, usually more revolute leaf-margins, and lower leaf surface distinctly pallid from minute (0.2–0.3 mm. long), very closely appressed white hairs.

Section *Lasioglottis*, sect. nov.

Flores monomorphi. Stamina sub altitudinibus inaequalibus inserta; filamentis inaequalibus. Corollae extus saepe strigosae; faucibus intus antrorse villosa-strigosis et non rariter glanduliferis. Nuculae minute abundanterque tuberculatae opacae cicatrice appendiculam erectam gracilem elongatam canale funiculari inclusam proferente donatae.

Lithodora diffusa (Lag.) Johnston, Contr. Gray Herb. 73: 56 (1924).

Lithospermum diffusum Lag. Varied. Cienc. 4^e: 39 (1805).

Lithospermum prostratum Lois. Fl. Gall. 105 (1806).

Lithodora prostrata (Lois.) Griseb. Spicileg. Fl. Rumel. 2: 531 (1846).

As here accepted, the species is given the very broad definition almost universally accepted by past authors. It includes a very variable group of plants ranging in western France (north to Finistère), in western and southern Spain, and in Portugal and Morocco. The species needs a detailed study. A number of varieties have been published, but these are based on rather intangible differences in gross habit. No attention has been given to characters revealed only by the dissection of the corolla. Some of these appear to be geographically correlated, and when properly studied will probably be useful in defining really significant varieties (and possibly segregates) of the species. Between northern and southern forms of *L. diffusa* I have noted differences in length of style, size of anthers,

lobing of anthers, and abundance of hairs and glands in the corolla-throat.

In having the filaments unequal and affixed at unequal heights on the corolla-throat, and in having the corolla-throat usually conspicuously hairy, *L. diffusa* is not merely distinguished from its congeners — it has features unusual in the Boraginaceae. The irregular distribution of stamens in the throat seems most like that characteristic of two species of *Lithospermum*, cf. Jour. Arnold Arb. 33: 303 (1952). In those species, however, the filaments are equal and do not vary in length according to their high or low position in the throat, as in *L. diffusa*. The irregular androecia of all these species no doubt have a fixed orientation within the corolla, but this can be determined with certainty only by someone with a supply of fresh flowers for dissection. From my observations, the odd stamen, that affixed lowest down in the throat, seems to be located on the abaxial side of the flower. Possibly it alternates with the two anterior lobes of the corolla, which, in all the species mentioned, frequently seem to be more spreading than the three posterior lobes. The hairy corolla-throat of *L. diffusa* is also noteworthy. In some southern forms of the species the throat may be sparingly hairy or rarely nearly glabrous, but in the common forms of the plant the throat is densely clothed with evident slender, antrorsely appressed hairs. The stamens emerge from among the abundant hairs. This condition is found elsewhere in the *Boraginoideae* only in *Ancistrocarya*, *Sericostoma*, and *Echiochilon*.

2. *Moltkia* Lehm. N. Schrift. Naturfor. Ges. Halle 3²: (1817); Lehm. Asperif. 2: 339 (1818); Lehm. Icones 26, t. 43–44 (1821). — based on *M. punctata* Lehm. and *M. caerulea* Lehm.

Gymnoleima Decne. in Jacquemont, Voy. Ind. 4²: 122 (1844). Type species *Lithospermum graminifolium* Viv.

Lithospermum § *Gymnoleima* [Decne.] Endl. Gen. Pl. Suppl. 3: 77 (1843).

Plants perennial. Stems herbaceous or more or less fruticose, strigose. Leaves alternate, veinless. Cymes evidently bracted, solitary or clustered at the ends of the stems or branches, becoming elongate and evidently unilateral at maturity. Calyx 5-parted, the lobes firm, linear, equal or nearly so. Corolla blue, purple or yellow, elongate and gradually ampliate or with a differentiated tube and swollen throat, glabrous inside and out or with some coarse hairs on the inner face of the lobes and on the adjacent throat; lobes imbricate, becoming erect, rounded, longer than broad to broader than long, equal or practically so; throat without glands or appendages; tube not developing an annulus, smooth and glabrous. Stamens affixed at equal heights above the middle of the corolla; filaments linear, with an evident midvein, equal or unequal, usually longer than the anther, short to very elongate; anthers included or more or less exserted, oblong to lanceolate, straight to strongly recurved, affixed at or near the middle or distinctly below the middle, apex obtuse or emarginate or somewhat apiculate, theca more or less distinct at the base. Pollen sphaeric or slightly longer than broad, small (16–31 μ), pores 3–8, equatorial. Style very slender, filiform, eventually exserted beyond the corolla-

lobes, terminated by a very small entire or weakly lobed stigma. Nutlets smooth and lustrous or minutely tuberculate or papillate and opaque, bent ventrally above the base; ventral keel usually prominent, bearing a closed more or less fused suture; attachment scar large, morphologically basal but because of the bend in the nutlet body appearing to be obliquely basal or suprabasal, ovate or ovate-triangular, flat or concave. Embryo more or less curved or bent, tip of cotyledons directly above the nutlet attachment. Gynobase pyramidal when bearing four nutlets, flat when only a single nutlet is matured.

The six species of *Moltkia* are equally divided between two well-marked sections, one confined to southern Europe from northern Italy to northern Greece, the other to western Asia from Anatolia to Transcaucasia and northwestern Iran. The genus has been confused with *Lithospermum* and some of its species have been persistently referred to it, particularly by gardeners. *Moltkia*, however, differs from *Lithospermum* in having a corolla with erect lobes, glabrous outer surface, and an unappendaged non-glanduliferous throat, as well as a very slender, eventually long-exserted style, a very small entire or only weakly lobed stigma, and not straight, but distinctly bent nutlets. In its fruit *Moltkia* is most like *Halacsya* and *Alkana*, and its relations are probably closer with these genera than with *Lithospermum*.

The most recent treatment of the genus is by Wettstein, Oesterr. Bot. Zeitschr. 67: 361-69, f. 1-6, t. 3 (1918), who discussed its characters and illustrated the flowers and fruit of most of the species. Among the eight species he admitted to the genus, however, two must be excluded. The plant he accepted as *Moltkia callosa* (Vahl) Wettst. represents the recently proposed monotypic genus *Moltkiopsis*, cf. Jour. Arnold Arb. 34: 3 (1953). His *Moltkia parviflora* (Decne.) Wettst. belongs with the Himalayan representatives of *Mertensia*, with which it agrees in having sparingly bracted inflorescence and very distinctive nutlets. Neither of these two excluded species has any close affinity with *Moltkia*.

Although the nutlets of *Moltkia* appear to have an attachment that is obliquely basal or even suprabasally lateral, the attachment is, in a morphological sense, truly basal. A medio-longitudinal section of the nutlet reveals that the embryo is curved but has the distal portion of its cotyledons located inside the pericarp directly above the attachment scar and in a plane vertical to it, the relation in all basifixed nutlets. The longitudinal section shows further that the nutlet body is bent, at or distinctly below the middle, 45°-90° inward towards the center of the flower. It is because of this distortion of the nutlet body that the attachment has the appearance of being oblique or suprabasal when actually it is basal on the only portion (the lower third to a half) of the body which is morphologically erect. When only one of these nutlets is matured in a flower, and, as a result, the gynobase is not elevated, the nutlet body is more or less horizontal or obliquely ascending. In flowers which mature four nutlets, the gynobase does elevate and is pyramidal and about as broad as high. Straight basifixed nutlets, such as those of *Lithospermum*,

if borne on this pyramidal gynobase, would be very strongly divergent. Since the basifixed nutlets of *Moltkia* are bent, when they are affixed on the pyramidal gynobase their bent form corrects any tendency to divergence, and their tips become connivent and their long axes seem parallel.

The behavior of the androecium in the maturing corolla of *Moltkia* has interesting diversity and some puzzling aspects. Two of the species (*M. Dörfleri* and *M. suffruticosa*) have included stamens with short filaments that have reached their maximum length as the corolla opens. In the four other species of the genus, however, the filaments elongate conspicuously after the corolla opens and eventually become evidently exerted beyond the corolla-lobes. The filaments of the five stamens within a flower do not elongate simultaneously. In *M. caerulea* and *M. longiflora* the individual stamens elongate according to an obvious pattern. The filament of the median forward stamen elongates first, then the filaments of the posterior lateral pair of stamens, and finally those of the anterior lateral pair. Those elongating last never become as long as the other three. As a result, the androecium has evident bilateral symmetry. In *M. aurea* and particularly in *M. petraea* the androecium has no such pattern. Although the filaments eventually become about equally elongate, the rate of elongation and the time of its initiation may differ for each of the five stamens. Indeed, for an interval between the time that the corolla opens and the time the stamens are fully exerted, the filaments of a given flower may all have different lengths. On some plants of *M. petraea* the sequence of elongation seems possibly even in accord with a 2/5 phyllotaxy. The matter deserves attention from someone who has fresh flowers available for observation.

As in other genera of this relationship, the anthers of *Moltkia* dehisce and spill out much of their pollen just before the corolla opens. At this time the style usually surpasses the anthers, and the stigma has a position at the top of the bud above the anthers. Only in some (not all) flowers of *M. caerulea* have I found the style shorter at this stage, i.e., with the stigma borne between and not above the anthers. In *M. Dörfleri* and *M. petraea*, indeed, the style is so elongate that it is accommodated within the closed corolla only by becoming contorted or by having its apex appressed against and even decurved against the still tightly folded corolla-lobes. After the corolla opens the style elongates. In the species having exerted stamens, although the style reaches maximum extension promptly, the elongating filaments eventually raise the anthers to the same height as the stigma or nearly so. What purpose and interrelation the described sequences of changes may have in effecting pollinization is obscure. Since the anthers dehisce and lose much if not all of their pollen while still included in the corolla, their subsequent extrusion would seem to have little purpose.

The generic name *Gymnoleima* was published rather casually by Decaisne in a brief very general discussion of the affinities of the Himalayan species now referred to *Mertensia*. As a proposed segregate of *Lithospermum* it was launched as follows: "Je désignerais par le nom de *Gymnoleima*

les *Lith. graminifolium*, *oleifolium*, *rosmarinifolium* et *fruticulosum*, dont la gorge de la corolla n'offre aucun appendice, dont le stigmate est plus ou moins échancré, . . ." Of the species mentioned, the first belongs to *Moltkia* and the remaining three to *Lithodora*. The genus has never been accepted. The only binomials under the genus are the four attributed to Decaisne, which appear in print for the first and only time in the Index Kewensis. Since Decaisne's brief characterization of *Gymnoleima* applies equally well to all the species he lists, I have accepted the first mentioned, *Lithospermum graminifolium*, as the type of the genus. *Gymnoleima* accordingly becomes a synonym of *Moltkia*. This is desirable, for any other typification would bring *Gymnoleima* (1844) into competition with the later *Lithodora* (1845).

Section Eumoltkia.

Nutlets with roughened opaque surface, very abundantly and minutely tuberculate or papillate and also coarsely warted, rugose, or pitted, apex of nutlet rounded. Attachment surface of the nutlets and faces of the gynobase green. Corolla with a well-differentiated, more or less swollen throat. Filaments arising from 5 weak invaginations at the base of the corolla throat, elongate, equal or nearly so or 2 distinctly shorter than the other 3. Anthers affixed between the base and middle, becoming conspicuously recurved. Pollen sphaeric or nearly so, polar profile circular or somewhat 3-sided, lateral profile circular or nearly so, pores remaining obscure, apparently 3 and equatorial.

Moltkia caerulea (Willd.) Lehm. N. Schrift. Naturf. Ges. Halle 3²: 6 (1817).

Onosma caerulea Willd. Sp. Pl. 1²: 775 (1798).

Moltkia punctata Lehm. N. Schrift. Naturf. Ges. Halle 3²: 5 (1817).

Cynoglossum rugosum Willd. ex R. & S. 4: 764 (1819); Cham. Linnaea 4: 447 (1829).

Lithospermum rugosum (Willd.) DC. Prodr. 10: 83 (1846).

Moltkia anatolica Boiss. Diag. ser. 1, 11: 114 (1849).

Ranging from western Anatolia into Transcaucasia and northwestern Iran. Corolla elongate, 11–19 mm. long, with blue lobes and throat, bearing scattered straight, stiff, antrorsely and loosely appressed hairs on the inner surface of the lobes and adjacent throat but otherwise completely glabrous, lobes 1.5–1.7 mm. long, usually with a thickened papillate midrib, throat 3–4 mm. long. Stamens eventually exserted, usually surpassing the corolla-lobes; filaments 4–7 mm. long, those of the adaxial lateral pair of stamens and the single anterior median stamens 1 mm. longer than those of the two anterior lateral stamens; anthers purpurecent, 2–2.5 long, attached 1 mm. above the base. Pollen 25–28 μ , surface perhaps minutely rugulose. Style evidently surpassing the filaments. Nutlets irregularly ovoid, 3–4 mm. long, bent at a 90° angle below the middle, pericarp thick and bony, surface densely and minutely low-papillate and also coarsely roughened by low broad ridges and warts and by coarse pitting, attachment scar

large and usually bright green. Gynobase bearing chlorophyll, when maturing 4 nutlets becoming pyramidal and ca. 1.5 mm. high.

This species shares several noteworthy features with the closely related *M. longiflora*. Especially interesting is the presence of rather numerous stiff, loosely appressed, upwardly directed hairs in the throat of the corolla and on the inner face of the corolla-lobes. These relatively coarse hairs would seem to be a hindrance to any insect seeking to enter the corolla, but if they function as a barrier they would seem to have little purpose, since there is no annulus in the corolla-tube and since the anthers and style eventually become exerted from the corolla. Also unique in the genus is the development of distinctly unequal filaments. The androecium has a very clear bilateral symmetry, but the corolla seems to be otherwise regular, or at most has its two abaxial lobes only very slightly more spreading than the other three.

Moltkia Kemal-Paschii Bornm. Magyar Bot. Lapok 30: 66 (1931), is a putative natural hybrid between *M. caerulea* and *M. aurea* from the mountains of central Anatolia. Authentic specimens of the hybrid are before me. Its anthers contain extremely few grains of pollen that are perfect. From *M. aurea* it has acquired a pale corolla, but in other respects characters of *M. caerulea* predominate in the hybrid.

Moltkia longiflora (Bertol.) Wettst. Oesterr. Bot. Zeitschr. 67: 368 (1918).

Echium longiflora Bertol. [Misl. Bot. 1:] Nov. Comment. Acad. Sci. Inst. Bonn 5: 425 (1842).

Moltkia angustiflora DC. Prodr. 10: 72 (1846).

Known only from eastern Syria and northern Iraq. A very close relative of *M. caerulea* which differs in geographic range, in habit of growth, and in fruit. It is readily distinguished from its relative by its longer, much more slender, strict fruticulose stems, and usually longer and always more slender corollas. The fruiting calyx is subsessile, not borne on a stout pedicel 1–2 mm. long, as in *M. caerulea*. The nutlets are half the size of those of *M. caerulea* and have a very much thinner pericarp bearing not low rounded but very prominent warts.

In *M. longiflora* the stems apparently arise directly from the center of a functioning winter rosette of leaves. The lower leaves on the flowering stems, though rarely persisting, are larger than the middle and upper ones. Flowering plants develop no sterile radical leaf-clusters such as those usually present in *M. caerulea*. In *M. caerulea* the stems arise from among the remnants of a basal leaf-cluster developed the previous season. Its lowest cauline leaves, usually persisting at flowering time, are commonly distinctly smaller than those higher up the stem.

Moltkia aurea Boiss. Diag. ser. 1, 4: 49 (1844) and Fl. Orient 4: 222 (1875).

Known only from western and central Anatolia. Corolla bright golden yellow, completely glabrous, 7–9 mm. long, with a short tube 3.5–4 mm.

long and an abruptly swollen campanulate throat 4–5 mm. long, lobes broader than long, 1–2 mm. long or nearly so. Filaments 3.5–6 mm. long, eventually much surpassing the corolla-lobes; anthers yellow, 1.5–2.5 mm. long, strongly recurved, attached ca. 0.5 mm. above the base, apex rounded, base of each anther-sac apiculate. Pollen 22–25 μ diameter. Nutlets with a thick pericarp, bent about 90° at the middle, 2.5–3 mm. high, maximum length 4–5 mm., clothed with an abundance of very minute elongate papillae, coarsely roughened by low broad ridges and tuberculations and frequently coarsely pitted. Gynobase pyramidal, ca. 1 mm. tall. Style exerted before the stamens but usually eventually surpassed by them.

Notable for its yellow corolla with campanulate throat. In vegetative characters and general habit it is very similar to *M. caerulea*.

Section *Echianthus* (Vis.), comb. nov.

Lithospermum § *Echianthus* Visiani, Fl. Dalmat. 2: 247 (1847). Type species *L. petraeum*.

Moltkia § *Lithospermoideae* Boiss. Fl. Orient. 4: 221 (1875). Type species *Lithospermum petraeum*.

Nutlets smooth, lustrous, more or less pointed. Attachment scar of nutlet and faces of the gynobase not green. Corolla gradually ampliate from the base, lacking a sharply differentiated throat. Filaments not arising from invaginations of the corolla, short to elongate, included or exerted, equal or nearly so. Anthers affixed at or very slightly below the middle, straight or only very weakly falcate. Pollen perceptibly longer than broad, globose-ellipsoidal, polar profile circular or sometimes polygonal, lateral profile frequently with obtusely angulate sides, pores equatorial, usually 6–8, frequently protrudent.

Moltkia petraea (Tratt.) Griseb. Spicileg. Fl. Rumel. et Bithyn. 2: 515 and 532 (1846).

Echium petraeum Trattinnick, Thes. Bot. 8, t. 34 (1819).

Lithospermum petraeum (Tratt.) DC. Prodr. 10: 82 (1846); Visiani, Fl. Dalmat. 2: 247 (1847).

Dalmatia, from the vicinity of Split south into Albania. Plant frutescent, forming a small bush 2–4 dm. tall, much branched. Leaves oblanceolate, 1–5 cm. long. Corolla blue, 7–8 mm. long, gradually ampliate or with an ill-defined tube (2.5–3 mm. long) and throat (ca. 3.5 mm.); lobes elongate, ca. 1.5 mm. long and 1 mm. broad. Filaments affixed 2.5–3 mm. above base of corolla and eventually surpassing the corolla-lobes 3–3.5 mm. Anthers blue, 1–2 mm. long, straight or very weakly curved, affixed at or very slightly below the middle, apex rounded, base emarginate. Pollen smallest in the genus, 16–20 μ long, pores 8. Style surpassing the corolla 2–4 mm. Nutlets 2.5–3 mm. long.

In Europe widely cultivated in rock-gardens. Under garden conditions it crosses with *M. suffruticosa* and produces fertile hybrids. Two of these crosses bear binomials *Lithospermum intermedium* Froebel and *L. Froebelii* Sündermann, Allgem. Bot. Zeit. 12: 92 (1906).

Moltkia suffruticosa (L.) Brand in Koch, Synop. Deutsch. u. Schweiz. Fl. ed. 3, 3: 1999 (1903).

Pulmonaria suffruticosa L. Sp. Pl. ed. 2, 2: 1667 (1763).

Lithospermum suffruticosum (L.) Kerner, Sched. Fl. Aust.-Hung. 1: 52 (1881).

Lithospermum graminifolium Viviani, Ann. de Bot. 1²: 163, t. 14 (1804).

Lithodora graminifolia (Viv.) Griseb. Spicileg. Fl. Rumel. et Bithyn. 2: 530 (1846); Reichenb. Icon. 18: t. 114 (1858).

Moltkia graminifolia (Viv.) Nyman, Consp. Fl. Europ. 519 (1881).

A plant of northern Italy. From a trailing caudex of slender, loosely branched stems producing sterile clusters of very slender and elongate (5–15 cm. long) leaves and slender erect leafy flowering stems 1–2 dm. tall. Flowering stems arising from among the remnants of a sterile leaf-cluster of the previous season, its leaves 2–6 cm. long. Corolla blue, elongate, gradually ampliate, 15–17 mm. long; lobes elliptic, 3–3.5 mm. long, rounded. Filaments 2.5–3 mm. long, affixed 1.5–2 mm. below the sinus of the corolla-lobes (i.e., ca. 12 mm. above the base of the corolla). Anthers yellow, straight, ca. 3 mm. long, exserted from the corolla-tube but scarcely if at all surpassing the erect corolla-lobes, affixed ca. 1 mm. above the base, tip stoutly apiculate, base of theca acute, usually unequal. Pollen 20–22 μ long, pores (7 or) 8. Style very slender, eventually surpassing the corolla 3–4 mm.; nutlets 3 mm. long.

Moltkia Dörfleri Wettst. Anz. Akad. Wiss. Wien 55: 284 (1918) and Oesterr. Bot. Zeitschr. 67: 361 and 404, t. 3 (1918).

Known only from the mountains of northeastern Albania. Plant an herbaceous perennial, producing scattered simple erect leafy stems 3–5 dm. tall from a thick sympodial rhizome. Leaves lanceolate, all cauline, the lowest imperfectly developed. Corolla purple, elongate, gradually ampliate, 19–22 mm. long; lobes broad, rounded, 2–2.5 mm. long, 3.5–4 mm. broad. Filaments compressed, 1.5–2 mm. long, shorter than the anthers, affixed 13–14 mm. above the base of the corolla. Anthers yellow, elongate, straight, 2.5–3.5 mm. long, included (apex 0.5–1.5 mm. below the sinus of the corolla), affixed 1 mm. above the retuse base, apex bearing a pair of acuminate tips. Pollen largest in the genus, 28–31 μ long, pores 5–7 but usually 6, equatorial. Style filiform, eventually exserted 2–5 mm. beyond the corolla-lobes. Nutlets 4 mm. long, plump, minutely mottled with purple.

Although readily accommodated in *Moltkia*, this species has a number of unusual features. Its habit of growth is more suggestive of some of the perennial species of *Lithospermum* than of any of its congeners. Its annual flowering stems arise from a bud on the rhizome, and its lowermost leaves (small and imperfect) are conspicuously smaller than its middle and uppermost ones. The rhizome is unique in this group of genera. It is obviously sympodial, being made up of annual increments 3–4 mm. long which are thickest (7–10 mm.) near their attachment and then gradually contracted towards the stem-bearing end. The corolla is purple rather

than blue or yellow. Unlike those in other species, the anthers are longer, not shorter than the filaments, and are decidedly included rather than exserted from the corolla-tube. All species of *Moltkia* have a more or less papillate epidermis on the corolla-lobes. In *M. Dörfleri* the epidermal papillae have the maximum development and furthermore are usually tipped by an abortive trichome. Because of the large apiculate papillae, the corolla-lobes of the species appear to be puberulent when viewed under moderately high magnification. In this genus the calyx persists for some time after the nutlets have fallen away, and in all species save the present one eventually turns brown and falls off entire. In *M. Dörfleri*, however, the calyx-lobes disarticulate at the base and fall away individually before the base of the calyx detaches from the stem. I have studied five collections of this species (*Dörfler* 446, 450, 472, 502 and 848), duplicates of the five upon which the species was originally based. The last two of these, nos. 502 and 848, i.e., the last two cited by Wettstein, have glabrous anthers. The other three collections, however, and particularly no. 472, are notable for bearing scattered coarse appressed hairs on the sides of the anthers.

3. *Halacsya* Dörfler, Allgem. Bot. Zeitschr. 9: 46 (1903). — a renaming of *Zwackhia* Sendt. (1858), not Körber (1855).

Zwackhia Sendt. ex Reichenb. Icon. Fl. Germ. 18: 65, t. 1316 (1858). Type species *Z. aurea* Sendt.

Plant herbaceous, perennial. Leaves strigose, veinless, alternate. Cymes scorpioid, evidently bracted, solitary and terminal on leafy stems, becoming elongate and racemose at maturity. Calyx 5-parted, evidently pedicellate; lobes firm, lanceolate, equal or nearly so. Corolla yellow, completely glabrous, lobed to the middle; limb slightly oblique, most deeply lobed on the abaxial side; lobes narrowly imbricate in the bud, eventually ascending, elongate, broadly lanceolate or lance-elliptic, acutish, the two abaxial lobes smallest and least spreading; tube about as long as the lobes, lacking an annulus, upper third strongly ampliate and forming a short, ill-defined throat; throat bearing 5 rounded or triangular squamate appendages which alternate with the stamens and are borne at or slightly below the level of the filament attachments. Stamens borne at equal height low in the throat; filaments short, compressed, equal or nearly so; anthers oblong-lanceolate, only the apical portion exserted from the throat, affixed directly above the basal sinus, base cordate, apex acute and tipped by a short thickish prolongation of the narrow connective, margin of theca densely and coarsely short-ciliolate. Pollen sphaeric or slightly prolate, 30–37 μ long; pores equatorial, 3, usually swollen; polar profile circular or somewhat three-sided (with the pores medial on each of the three faces); lateral profile circular or slightly longer than broad. Style precociously long-exserted, terminated by a very small obscurely lobed or parted stigma. Nutlets compressed ovoid, bent, incurved above the middle, densely tuberculate or tuberculate-rugose, gray, opaque, back broadly convex, venter prominently keeled, suture closed and fused; attachment scar transversely

elliptic, basal on the erect lower half of the nutlet body; embryo weakly curved, tip of the cotyledons above the attachment scar and vertical to it. Gynobase depressed pyramidal when fully developed, attachment faces distinct, with narrow elevated cartilaginous margins.

An extremely well marked monotype which is known only from serpentine areas in southern Yugoslavia and adjacent Albania. For a general account of the plant and an excellent colored plate see K. Maly, *Wiss. Mitt. Bosn. u. Herzegowina* 20: 674-5, t. 11 (1907).

Halacsya Sendtneri (Boiss.) Dörfler, *Allgem. Bot. Zeitschr.* 9: 47 (1903).

Moltkia Sendtneri Boiss. *Diag. ser.* 2, 3: 138 (1857). — Bosnia, *Sendtner* 479.

Mertensia Sendtneri (Boiss.) Janka, *Oesterr. Bot. Zeitschr.* 9: 314 (1859).

"*Moltkia aurea* Boiss." sensu Sendt. *Das Ausland* 21: 424 (1848).

Zwackhia aurea Sendt. ex Reichenb. *Icon. Fl. Germ.* 18: 65, t. 1316 (1858). — Bosnia, *Sendtner* 479.

Mertensia serbica Janka, *Oesterr. Bot. Zeitschr.* 9: 314 (1859). — Serbia, *Pancic*.

Although the flowers of *Halacsya* eventually develop conspicuous yellow corollas 11-13 mm. long, they become sexually mature when very small and long before the corolla becomes conspicuous. Above the conspicuous flowers in the cyme is a series of gradually smaller ones which may have open corollas, long-exserted styles, and fully developed, even dehiscent anthers when the corolla is only 3-5 mm. long and accordingly only a fraction of its eventual size. In some of these juvenile flowers the corolla may even open when only 2.5 mm. long and when it is actually shorter than the calyx (ca. 3 mm. long). Usually the anthers have attained maximum dimensions (1.9 mm. long) and the style is well exserted when the corolla and calyx become as much as 5 mm. long. The corolla of such flowers is lobed to the middle and evidently zygomorphic, having the two abaxial lobes very distinctly (0.5-1 mm.) shorter than the posterior three. Their mature anthers, borne on filaments only half their eventual length, are disproportionately large in the incompletely developed corolla. They are almost completely exserted from the very short corolla-tube. In fact, in these juvenile flowers, the tip of the anther may almost reach the tip of the shorter corolla-lobes. The style emerges from the corolla very soon after it opens, and when the latter is only 4-6 mm. long may have attained as much as 10-15 mm. in length. It is only after the style is greatly extended and the anthers have dehisced that the corolla rapidly enlarges and achieves its mature form. A somewhat similar condition occurs among some of the American relatives of *Lithospermum*, as for example in *Onosmodium*, but I know of no parallel among any of the *Lithospermum* relatives in the Old World. In this group of genera such precocious sexuality appears to have some correlation with the type of corolla aestivation, since it is associated either with species that have their corolla-lobes valvate in the bud or with those, such as *Halacsya*, which have distinctly elongate corolla-lobes only very narrowly imbricate in the bud.

Fully developed flowers have a calyx 5–6 mm. long, a pedicel 1.5–3 mm. long, and a conspicuous deeply lobed yellow corolla 11–13 mm. long. The completely glabrous corolla has a funnelform outline but is lobed to the middle. The lobes of the slightly oblique limb are oblong-lanceolate and unequal. The two anterior lobes are 4–5.5 mm. long and 1.5–1.8 mm. wide, and the three larger posterior ones 5.5–6.6 mm. long and 2.5–3 mm. wide. The sinus on the anterior side of the corolla is 0.5–1 mm. deeper than that on the posterior. The tubular lower half of the corolla, ca. 1.5 mm. thick at the base, is most strongly ampliate in the upper third and so forms an ill-defined throat 4–5 mm. thick at the base of the lobes. There is no nectary developed near the base of the tube. The most unusual feature of these corollas is the five scale-like appendages borne in the throat, 4–5 mm. above the base of the tube. These are minute, rounded, or deltoid squamae which alternate with the stamens and are borne very slightly below the level of the filament attachments. At maturity they are usually a quarter to a third as long as the filaments. The primary vein supplying the corolla-lobes passes beneath the scales and is not detoured over them. They are, therefore, lamelliform and epidermal in origin and accordingly very different from the invaginate type of appendage present in such genera as *Lithospermum*.

The stamens of this genus are very distinctive. The short filaments (0.5–0.9 mm. long) are affixed at equal heights in the corolla 4.5–5 mm. above the corolla-base and usually very slightly above the squamate appendages. They are equal or nearly so, or possibly the posterior filaments may be almost imperceptibly longer than those of the anterior three. The anthers are oblong-lanceolate, 1.5–1.9 mm. long, acute and stoutly appendiculate at the apex and distinctly cordate at the base. Their attachment is just above the basal sinus, about 0.3–0.4 mm. above the base of the theca. The most unusual feature of the anther is the ciliate fringe of short stout hairs decorating the margins of the theca. In fully developed flowers the anthers on the more deeply lobed anterior side of the corolla have their upper half or third projecting above the base of the adjacent corolla sinus. On the posterior side of the corolla usually only the tip of the anther is to be seen projecting above the base of the sinus.

The stoutly beaked nutlets are about 3 mm. long and are gray and densely tuberculate. The body is somewhat dorsi-ventrally compressed and above the middle is bent about 45° inward towards the center of the flower. The ventral keel is prominent and the suture completely closed and fused. The attachment scar is basal on the erect lower half of the nutlet and is broader than long. When maturing four nutlets the gynobase is broadly pyramidal. Its attachment surfaces are distinct and each has a narrow pale cartilaginous margin.

The plant is perennial and apparently forms a loose multicapital caudex. The radical leaves, 5–15 cm. long, occur in sterile clusters. The simple erect or ascending stems, 2–4 dm. tall, have middle and lower leaves of about equal size and spring from a site occupied by a cluster of radical leaves of the previous season.

The genus is a very distinct one but probably has its closest relationship in *Moltkia* § *Eumoltkia*, as indicated by similarities in nutlets, style, stigma, pollen, and habit of growth. The very distinctive anthers of *Halacsya*, as well as its deeply lobed zygomorphic corolla with squamate appendages, readily distinguish it not only from *Moltkia* but from all other genera of this affinity. Although sometimes classed with *Echium* because of its zygomorphic corolla, its relationship with that genus is only of the most general sort.

4. **Alkanna** Tausch, *Flora* 7: 234 (1824), nom conserv. prop. Type species *A. tinctoria* (L.) Tausch [non *Alkanna* Adans. *Fam.* 2: 444 (1763) = *Lawsonia* L. (1753)].

Baphorhiza Link, *Handb.* 1: 578 (1829). Type species *A. tinctoria* (L.) Tausch.

Campylocaryum DC. ex Meisner, *Pl. Vasc. Gen.* 1: 280, and 2: 189 (1840). Type species *A. lutea* (DC.) Moris.

Camptocarpus C. Koch, *Linnaea* 17: 304 (1843). Type species *A. orientalis* (L.) Boiss.

Onochiles [Tournef.] Bubani, *Fl. Pyrenaea* 1: 491 (1897) — a renaming of *Alkanna* Tausch (1824), not Adans. (1763).

Plant herbaceous, mostly perennial, frequently glanduliferous. Leaves numerous, alternate, veinless. Cymes scorpioid, leafy-bracted, usually solitary or geminate at the ends of leafy stems, elongate and racemose in age. Calyx 5-lobed, short-pedicellate, in fruit moderately accrescent, broadened at the base and usually deflexed; lobes equal, narrow to broadly lanceolate, usually attenuate, in age connivent. Corolla yellow, whitish or blue, salverform or infundibuliform, regular or zygomorphic, outside glabrous or in a few species inconspicuously hairy; tube usually cylindric and with its upper portion not differentiated into a well-defined throat, glabrous or exceptionally with minute hairs below the tumid annular or 10-lobulate suprabasal annulus; limb with loosely ascending broad rounded lobes; throat on inner surface usually bearing abundant stipitate glands. Appendages of the corolla borne near the middle of the tube or at the base of the throat, included, alternating with the stamens, usually transversely oblong or trapeziform, glabrous, sometimes minutely papillate at the summit, borne at the same height in the corolla and all equal, or 3 adaxial ones borne slightly higher than the other 2 and sometimes differing in degree of development. Stamens 5, equal, included, in a few species borne at equal heights in the corolla-tube and all attached below the appendages, but in most species borne in two groups, one at a higher level than the other, the 3 abaxial stamens being affixed at or slightly above the level of the appendages and the 2 adaxial ones affixed distinctly below the appendages. Filaments a half to two thirds as long as the anthers; anthers affixed at or near the middle. Pollen conic with rounded base or rarely ovate-oblong, 16–21 μ long, broadest and bearing the 3 pores above the rounded base, summit acute with only the tip rounded or rarely broad and rounded, polar profile circular, pores very obscure. Style entire or

obscurely bilobed at the very apex, included in the corolla-tube, rarely surpassing the anthers; stigmas very small, 2, usually broader than long, apical and juxtaposed or subterminal on opposite sides of the style tip, simple or somewhat bilobed. Nutlets 4 or more commonly 1-3 aborting, verrucose or scrobiculate-rugose, short-stipitate, strongly bent, usually with the long axis more or less horizontal and the attachment apparently suprabasally lateral (attachment actually on morphological base of nutlet body), back rounded, ventral keel prominent, formed of a fused suture. Gynobase swollen, lobed to form distinct pulvini supporting the concave ovate attachment surfaces.

A very well marked and interesting genus greatly in need of monographic study. The twenty-five to thirty species occur in the Mediterranean area and eastward to Transcaucasia and northern Iran, in greatest concentration and diversity in Anatolia and Greece.

The corolla of *Alkanna* usually bears invaginate appendages, not exposed in the mouth of the corolla as in most Boraginaceae but deeply included in the corolla-tube or -throat where they are revealed only when the corolla is dissected. The included appendages of *Alkanna* possibly may have a parallel in the interstaminal appendages of *Halacsya*, but otherwise the condition is unknown in related genera. The appendages have a characteristic development in each of the three sections of the genus. Another common feature of the corolla is the abundant development of stipitate glands on the corolla walls above the stamens. These glands are present and evident in all species except *A. lutea*. In no other genus of this relationship are they so abundant and conspicuous.

The nutlets of *Alkanna* are excessively bent and evidently short-stipitate. Except for the stipitate attachment they are fundamentally similar to those of *Halacsya* and *Moltkia*. In all three genera the nutlet body is distorted as a result of a sharp medial bend, 45-90° in *Halacsya* and *Moltkia* but about 130° in *Alkanna*. The embryo inside the nutlet is bent also, that of *Alkanna* usually having a very distinct transverse flexure near the middle of the cotyledons. It is to be especially noted that these nutlets are distorted only above the middle and that below they are similar to other nutlets of the Lithospermeae. Inside their basal section, the lower half of the cotyledons is vertical to the attachment scar, and the tips of the cotyledons are directly above it, as in all truly basifixed nutlets. Although the nutlet has a bend near the middle, its basal section remains straight or practically so and bears its attachment at the lower end. In *Alkanna* the nutlet can become arched or even more sharply bent, so that its morphological tip is brought down to nearly the same level as the attachment end, and, in some species, even proximate to it. Because the nutlet is bent double, its long axis is not vertical but transverse. Because the nutlets are transverse elongate, the attachment has the appearance of being suprabasally lateral, and numerous authors have so described it. Although this may be empirically correct, it is not so morphologically, for despite appearances, the nutlets, though distorted, still retain an erect base and a truly basal attachment.

In this genus the gynobase also is distinctive. When maturing a full complement of nutlets it is not angulate and more or less pyramidal as in related genera. It is pale in color, cartilaginous in texture, and swollen, and bears each of the four broad attachment surfaces elevated on distinct cushion-like lobes. The attachment surfaces are oblique, ovate, and distinctly concave. The nutlets, when attached, have the broadened tip of their basal stipe seated in these concave surfaces.

Two types of pollen occur in *Alkanna*. In one species, *A. lutea*, the grains have a form similar to that found in *Lithospermum*, but in all other species of the genus they are somewhat conic and show great similarity with the pollen of *Echium*. The conic grains are nearly as broad as long. They have a convex base and well-developed straight sides converging on a blunted rounded apex. The three pores, perhaps in ill-defined furrows, are arranged equidistant about the grain above its base, where it is broadest. The pollen of *A. lutea*, however, is somewhat ovate-oblong. It also is broadest above the convex base, and also has its pores located where its diameter is greatest. Above the level of the pores it is at first abruptly constricted, to form short but well-defined upwardly sloping shoulders, and then, above the middle of the grain, becomes very gradually narrowed. Towards its rounded summit the grain is narrowed to about half of its maximum basal diameter. I have found the pores on this ovate-oblong pollen of *A. lutea* difficult to discern. There seem to be three pores usually developed, but sometimes as many as four.

The two kinds of pollen in *Alkanna* are readily homologized as additional manifestations of a type of pollen asymmetry previously observed and discussed in *Lithospermum*, Jour. Arnold Arb. 33: 310-11, f. 1 (1952). The pollen of *A. lutea* obviously has the distinctive features previously noted in the asymmetric grains of *Lithospermum*. The pores have the same position on the grain, being borne where the grain is broadest, just above its curved convex base and directly below the first sharp constriction that forms the distinctive shoulders in all such asymmetric grains. In the conic grains found in all other species of *Alkanna*, the pores have a similar position. They are borne above the convex base where the grain is broadest and directly below the sharp constriction. These conic grains differ from the ovate-oblong ones of *A. lutea* only in the form of their upper half. In *A. lutea* the constriction is at first abrupt (forming the shoulders) and then becomes very gradual in the upper half of the grain. In the other species of the genus the first abrupt constriction continues uninterrupted into the upper half of the grain and on to its apex. The conic form of these grains is the result of an exaggerated continued upward prolongation of the usually limited constriction that forms the shoulder in other asymmetric grains.

Although showing some resemblance to that of *Lithospermum* in asymmetric form, the pollen of *Alkanna* differs in having fewer pores, usually only three. Interestingly, the triporate condition is that found in the globose or subglobose symmetric pollen of *Halacsya* and *Moltkia* §

Eumoltkia, the two groups which appear to be most closely related to *Alkanna*.

The generic name *Alkanna* Tausch (1824) has an early homonym in *Alkanna* Adans. Fam. 2: 444 (1763), a synonym of *Lawsonia* L. (1753), cf. Schwarz in Fedde, Repert. 47: 288 (1939) and Font-Quer & Rothmaler in Fedde, Repert. 50: 286 (1941). However, as a name proposed for conservation, *Alkanna* Tausch is listed among the Nomina Generica Conservanda in the recently published Code of Botanical Nomenclature, Utrecht, pg. 130 (1952). If the name *Alkanna* is rejected, the next available for the genus is *Baphorhiza* Link (1829). Only three binomials have been proposed under the latter genus, *B. tinctoria* Link (1829), *B. lutea* Font-Quer & Rothmaler (1940), and *B. orientalis* (L.) Font-Quer & Rothmaler (1940). *Alkanna*, as a well-established name associated with over sixty binomials, deserves conservation, and pending final judgment, should be retained.

Section Eualkanna.

Alkanna § *Baphorhiza* DC. Prodr. 9: 97 (1846).

Stamens borne at unequal heights in the corolla, two affixed below the appendages and surpassed by them and three affixed at or slightly above the level of the appendages and surpassing them; appendages transversely oblong or trapeziform, invaginate; pollen conic, with a broad convex base and a rounded tip, 16–17.5 μ long, 14–16 μ broad, broadest and bearing the 3 equally spaced pores 5–7 μ above the base, polar profile circular, lateral profile with a broad rounded base and straight, strongly convergent sides; corolla zygomorphic, densely glanduliferous inside above the appendages; plant perennial.

This section embraces all but two of the twenty-five or thirty species of the genus. Its best known and most widely distributed species are *Alkanna orientalis* (L.) Boiss. and *A. tinctoria* (L.) Tausch.

In this section the corollas are distinctly zygomorphic. The two abaxial lobes of the corolla (outermost in the bud) are more spreading than the other three, the three abaxial stamens are borne higher on the tube than the other two, and the corolla tube below the stamens has constrictions that are usually conspicuously stronger on the abaxial side. The corolla, blue, whitish, or yellow, has a well-developed tube and an abruptly expanding limb but no well-differentiated throat. It is usually completely glabrous. Only in a few species is it sparingly hairy outside, particularly on the lobes, or inside about the nectary low in the tube. In all species the corolla bears an abundance of stipitate glands on the inner surface of the tube above the stamens. In most species the tube of the corolla is longer than the breadth of the limb. At or above the middle it bears small invaginate appendages alternating with the stamens. Interestingly, those on the abaxial side of the tube tend to have a very slight but still perceptibly higher position (and rarely also a greater or a less development) than those on the opposing side of the tube. Associated with the appendages are two groups of

stamens, an abaxial set of three affixed at or slightly above the level of the appendages, and an adaxial set of two affixed distinctly below them. The anthers of the upper group much surpass the appendages, while those of the lower group at most reach up only to the base of the appendages. The filaments are short, shorter than the anthers, and those of the upper stamens possibly very slightly longer than those of the lower stamens.²

Section *Allolepis*, sect. nov.

Stamina infra appendiculas corollae aequaliter affixa; antheris appendiculas superantibus; appendiculis quadratis grandis solum infra medium invaginatis; granulis pollinis conicis eis sectionis *Eualkannae* similibus; faucibus corollae evidenter differentiatis tubo longioribus intus glandulis stipitatis obsitis; planta perennis.

A monotypic section containing only *A. scardica* Griseb., a plant of the mountains of northern Albania and adjacent Montenegro. Of this very distinct species two generous collections have been available for dissection (*Dörfler* 123 and 713). The blue corollas are regular and are sparsely villulose outside above the middle and very minutely hairy inside below the tube-nectary, but are otherwise glabrous. They have a short tube and a large well-differentiated campanulate throat about twice as long. The inner surface of the throat is abundantly stipitate glandular. The corolla appendages, borne at the base of the large throat, are the largest in the genus. They are quadrate in form and have only their lower third or half formed by invagination. The veins supplying the corolla-lobes enter the appendage and make a detour, not over the summit of the appendage, but only over its lower half. The upper half or two thirds of the appendage is a lamelliform prolongation of its invaginate basal portion. It is epidermal in origin. The stamens of *A. scardica* are the largest in the genus. The filaments (about half the length of the anthers) are affixed distinctly below the appendages, all at the same height above the base of the corolla. The anthers (ca. 1.5 mm. long) are borne with their middle at about the same level as the base of the corolla appendages and, unlike those of all congeners, project not only below the appendages but above them also.

Section *Campylocaryum* A.DC. Prodr. 9: 102 (1846).

Stamens affixed at equal heights in the corolla and borne entirely below the obscure, weakly developed, low-convex appendages; pollen ovate-oblong, 20–21 μ long, 14–16 μ broad, broadest and bearing its 3 pores ca. 8 μ above the hemispheric base, thereafter at first abruptly and then (above

² The organization of the androecium in *Alkanna* was given incorrectly in my recent discussion of *Moltkiopsis*, cf. Jour. Arnold Arb. 34: 3 (1953). As in *Alkanna* two of the five stamens of *Moltkiopsis* have filaments shorter and attached slightly lower on the corolla than the other three. Unlike *Alkanna*, however, the two shorter and lower stamens in *Moltkiopsis* are not juxtaposed nor are they adaxial. They are separated by a long stamen (the abaxial medial one) and appear to represent the two abaxial lateral members of the androecium.

the middle of the grain) more gradually narrowed to the rounded summit, polar profile circular, lateral profile with short, steeply sloping shoulders above the broad rounded base and above the middle with nearly straight sides weakly converging towards the rounded summit. Corolla regular, tube becoming ampliate above the middle and forming a moderately well differentiated throat, bearing no stipitate glands on its inner surface; plant annual.

A monotypic section containing only the single species *A. lutea* (DC.) Moris of southern France, eastern Spain and Sardinia. It is the only annual species in the genus. Its small yellow corollas are regular. Except for minute hairs associated with the annulus, they are completely glabrous. Unlike those of other species in the genus, the corollas of *A. lutea* bear no stipitate glands in the throat. The very small stamens are borne below the middle of the corolla. The appendages at the base of the ill-defined throat are very weakly developed and obscure. At most, they are usually only vague convexities and are revealed only when the corolla is viewed under high magnification. The nutlets are very small.

5. *Echium* [Tournef.] L. Sp. Pl. 139 (1753) and Gen. Pl. 68 (1754).
Type species *E. vulgare* L.

Isoplesion Raf. Fl. Tellur. 4: 86 (1836-38). — based on *E. italicum* L., *E. giganteum* L., *E. pyrenaicum* L., and *E. rubrum* Jacq.

Larephes Raf. Fl. Tellur. 4: 86 (1836-38). Type species *E. parviflorum* Moench.

Argyrexias Raf. Fl. Tellur. 4: 86 (1836-38). Type species *E. candicans* L.
Megacaryon Boiss. Pl. Orient. Nov. Dec. 1: 7 (1875) and Fl. Orient. 4: 203 (1875); Lacaita, Jour. Linn. Soc. Bot. 44: 393 (1919). Type species *E. orientale* L.

Echium § *Eleutherolepis* Coincy, Cong. Intern. Bot. Paris, Actes 349, fig. (1900). Type species *E. albicans* Boiss.

Echium § *Gamolepis* Coincy, Cong. Intern. Bot. Paris, Actes 349, fig. (1900). Type species *E. angustifolium* Lam.

Echium § *Pachylepis* Coincy, Bull. Herb. Boiss. ser. 2, 3: 261 (1903). Type species *E. candicans* L.

Plants annual, biennial or perennial, small to very large, herbs, shrubs or small trees, hispid or strigose; leaves usually without evident veins. Inflorescence consisting of elongating scorpioid cymes borne terminally on the stems and leafy branches, or of abundant usually small scorpioid cymes aggregated into a usually dense very elongate thyrses; cymes simple or sometimes forked, densely flowered, abundantly and evidently bracted. Calyx 5-fid or rarely with a short tube, usually pedicellate; lobes usually slender and attenuate, rarely becoming broadly lanceolate or somewhat elliptic, accrescent and connivent in fruit, the two adaxial lobes usually smallest. Flowers monomorphic or gynodioecious, perfect or with the stamens and pollen imperfectly developed. Corolla blue, purple or pink, rarely white or red, resupinate, more or less distinctly zygomorphic, some-

times tubular but usually narrowly to broadly infundibuliform, usually most prolonged on the two-lobed abaxial side; limb usually oblique; lobes ascending, sometimes equal or rarely the three adaxial ones largest, but prevailing with the two abaxial ones most developed; tube usually short, commonly bent or abaxially swollen just above the base; outside of corolla usually hairy, usually marked with short vertical inflexures under the stamen-attachments; inside of corolla without faucal appendages or stipitate glands, glabrous except for hairs associated with the annulus; annulus borne extremely close to the base of the corolla-tube, very small, sparingly strigose or more or less villose or glabrous, commonly represented by 5–10 lobes but rarely reduced to merely a lineate ring or to 5–10 swellings. Stamens 5, the adaxial pair borne highest on the corolla, the medial abaxial one lowest and the two abaxial lateral ones at an intermediate level, or the two abaxial laterals and the medial one all affixed at or about the same level and below the adaxial pair, or rarely all the stamens borne at or about the same level; the single medial abaxial stamen practically always distinguishable to some degree by the distinctive form of its filament and manner of attachment; filaments slender and elongate, sometimes all included but usually with two or more exserted, commonly declinate, glabrous or very rarely pilose, all equal or of two or three different lengths, usually with a thickened, somewhat decurrent base, the odd medial stamen frequently joined to the corolla by a membrane for a distance above its proper base. Anthers small, short-oblong to oblong, displayed in an inverted position with the emarginate base uppermost, attached to the filament in a pit near the middle of the broad, somewhat cartilaginous connective. Pollen ovoid or conic-ovoid ($16\text{--}26 \times 13\text{--}25 \mu$), broadest above the broadly rounded base and then gradually narrowed to the rounded apex; polar profile circular, usually with the pores slightly protrudent or their position marked by three nicks in the circumference; pores 3 (perhaps associated with short furrows), arranged equidistant about the broadest part of the grain. Style exserted, always bearing some slender appressed hairs, usually flattened and under transmitted light usually showing 2 distinct vascular strands at least above the middle, forked below the summit or exceptionally unbranched; lobes attenuate, frequently unequal; stigmas 2, distinct, terminal, capitate, very small. Nutlets ovoid or lance-ovoid, usually brownish and tuberculate, rarely lobulate-tuberculate or smooth or nearly so, dull or exceptionally lustrous, erect or somewhat divergent, straight or slightly incurved or sometimes strongly bent ventrally at the middle; venter with a well-developed elongate keel bearing a nearly obliterated suture, base rounded or more commonly narrowed and even constricted just above the attachment; attachment scar flat or slightly concave, usually small, medial or more commonly tending to be restricted to the ventral half of the nutlet base, usually more or less flabelliform, marked ventrally by a conspicuous pit (i.e., the open end of the funicular canal) and dorsally by an arc of two or more broken vascular strands. Gynobase flat or sometimes broadly pyramidal, usually maturing four nutlets.

A genus in great need of a monographer. It has never had a complete methodical study, and no comprehensive system exists for the classification of its species. Past work on the genus has been almost exclusively floristic. Some of this has been very discriminating, but in general it has been provincial in scope and much of it over-solicitous concerning minor variations. Named species have been needlessly multiplied and broader identities and relationships misunderstood or ignored. The nomenclature of the species is chaotic. Many of the familiar binomials no longer have precise application and have come to need special definition each time they are used. The genus in its present state is one of the most confused and confusing of the Boraginoideae and will probably continue so until it has been surveyed and organized by a monographer.

Echium has a very close relation in the South African genus *Lobostemon*. So close is the relationship, in fact, that with reason the two could be merged. Other affinities of *Echium* are much less evident. The genus, however, in a number of significant details shows similarity with *Moltkia*, *Halacsya*, and *Alkanna*, and in some degree probably has particular relations with that group of three genera. Though this affinity seems a very generalized one, it is at least closer than any existing between *Echium* and the other groups of the Lithospermeae.

Some fifty or more species of *Echium* are restricted to the Atlantic islands and especially to the Canary Archipelago, and to the Mediterranean area and adjacent regions. The ancestors of the modern genus probably became isolated in these two regions at an early date, since evolution in *Echium*, proceeding independently in the two centers, has had time to produce specialized modifications in habit of growth and distinctive elaborations of floral structure in each. It seems also probable that *Lobostemon* has arisen from other ancestors of modern *Echium* which became isolated in South Africa. That southern genus is obviously very closely related to modern *Echium* and is distinguished only by a high degree of specialization and modification of the annulus in the corolla-tube. Its particular specializations are essentially no more remarkable than the extreme and highly evolved growth-form evolved by the *Echia* of the Atlantic islands and may very well have been elaborated in about the same length of time. The indications are that *Echium* has been a plastic group which formerly had a very wide distribution and that subsequently, with its geographic range reduced to three isolated regions, has become specialized in a distinctive manner in each of them.

The species of the Mediterranean area are annual, biennial, or perennial herbs with a general facies of a sort conventional among the herbaceous borages. They may be loosely branched, with relatively few elongating scorpioid cymes terminating stems and leafy branches, or have an erect main axis bearing very numerous small cymes aggregated into a dense very elongate thyrses. A few become somewhat suffrutescent at the base, but most are distinctly herbaceous, and the majority are annuals or biennials. With the exception of a few very coarse biennials, such as *E. orientale* and

E. pomponium, the species are all less than a meter tall and most of them only about half that height.

On the Atlantic islands, however, the endemic species have become large plants, and some of them have developed the woody habit to a degree unparalleled elsewhere among the Boraginoideae. Some are coarse, long-lived, monocarpic plants, at first forming huge basal rosettes and later massive columnar inflorescences a meter or more tall. Others bear their leaves on the younger parts of a continuously elongating axis which after a period of years is terminated in a large, even gigantic thyrse. Some such plants attain as much as five meters in height. Still others are shrubs or small trees, decidedly ligneous and prevailingly with a loose branching of the candelabra type, normally becoming one to two meters in height. Most of the species of this latter type bear their leaves clustered at the ends of the loose branches and hence have the distinctive traits of the so-called "rosette-trees."

In evaluating the remarkable development of *Echium* on the Madeira, Canary, and Cape Verde islands, it is to be recalled that their distinctive habit is also paralleled on these islands by representatives of genera in other families which also have only lowly herbaceous, or at most only small fruticulose congeners elsewhere, e.g., *Sempervivum*, *Limonium*, *Sonchus*, etc. Although the particular factors which govern it may be in dispute, the fact remains that similar behavior is known to be associated with plants isolated on particular oceanic islands in various parts of the world. Good examples of this behavior are to be seen in the Revillagigedo and Juan Fernandez Islands, both off the west coast of America. Indeed, on the Juan Fernandez Islands there is another member of the Boraginoideae that parallels the behavior of the Atlantic islands *Echia*. This endemic genus, *Selkirkia*, is a small rosette-tree. It is one of the very few arborescent Boraginoideae and the only rosette-tree outside of *Echium*. Interestingly, it gives every evidence of being only an extreme insular modification of the herbaceous continental genus *Hackelia*.

Among the Lithospermeae the frutescent habit seems to be developed more frequently than in other tribes of the Boraginoideae. Certainly at least a tendency in this regard may have been well developed among the ancestors of modern *Echium*. Although evolution among the Mediterranean species seems to have been directed towards the development of the short-lived herbaceous habit, the shrubby habit persists in *Lobostemon* and may also have been present to some degree among the species of *Echium* originally isolated on the Atlantic islands. There is, however, no good reason for believing that the original *Echia* of the islands were more than suffruticose, or, at most, any more fruticose than modern *Lobostemon*. I cannot believe that the giant *Echia* of the islands have retained a primitive arborescent habit now lost by the more lowly congeners on the mainland, as has been suggested in some similar cases by those who insist that in the modification of stem-structure evolution can only proceed from the woody to the herbaceous (i.e., from trees and shrubs to herbs) and never *vice versa*. To accept this dictum would force us to consider those particular islands

in which plants display behavior comparable to that of *Echium* as merely refugia in which conservative old plants have been preserved and little changed. Very pertinent here is the high degree of incidence of the candlebra-type branching and the rosette-tree habit among woody insular representatives of groups which are elsewhere herbaceous. Though the habit of these plants is arborescent and distinctly woody, the type is an uncommon one. It is difficult to believe that this relatively uncommon growth form could be primitive in all the many genera of many different families which have only insular representatives displaying it. The frequency of its development on certain oceanic islands, particularly in members of groups elsewhere herbaceous, gives good reason for believing that it is somehow associated with the particular insular environment. It appears to be merely an epharmonic response shared by a wide variety of originally herbaceous or at most fruticose plants that have been allowed to develop in isolation under an equitable oceanic climate with all the benefits of a prolonged growing season. Although it must be accepted as an almost universal rule that evolution has proceeded from the arborescent towards the herbaceous, and stem structure from the ligneous to the herbaceous, there are reasons for believing these prevailing directions can in some instances be reversed under special insular conditions, and that under these conditions it is possible for a group of lowly plants to elaborate *de novo* woody stems and the arborescent habit. I am of the opinion that the insular *Echia* are a group of this sort, and that their arborescent habit and woody stems are elaborations rather than primitive. The gigantism and woody habit of these insular species are to be recognized as representing a high degree of specialization and as epharmonic in character.

The corollas of *Echium* are zygomorphic, and evidently so in all species except for a few in the Canary Islands. They are almost always distinctly bilabiate and most prolonged on the side which is bilobed and bears the individualized medial stamen. The side with the bilobed lip and the medial stamen is without doubt the side of the corolla facing away from the axis of the cyme. It is abaxial! Unhappily numerous authors have incorrectly identified it as to position. This confusion appears to have resulted from a misunderstanding of the peculiar behavior of the flower at anthesis. Unlike the flowers of most borages, those of *Echium* mature and display their corollas only on the dense curved uppermost section of the scorpioid cyme. At anthesis the pedicels bearing them are strict. Borne on the rounded uppermost part of the cyme and always directed towards the youngest part of the inflorescence, the pedicels tend to become more or less horizontal. The flowers they bear, accordingly, do not face away from the straightened, usually vertical older parts of the cyme as in most borages, but rather backwards over its coiled summit. They have become more or less horizontal in an unorthodox manner and in doing so have become resupinate. This condition — backwardly facing resupinate flowers — appears to be present in all species of the genus. To a casual observer and to the insect visitor the corolla of *Echium* has a three-lobed lower lip and a usually prolonged two-lobed upper one. In a functional and empiric sense these

can be referred to respectively as the anterior and posterior lips. If, however, they are to be identified morphologically, then the forward three-lobed lip is unquestionably the adaxial and the usually prolonged two-lobed rear lip is with equal certainty the abaxial one. Confusion of terminology in the past appears to have resulted from a lack of general awareness that the corollas of *Echium* are backwardly directed and accordingly resupinate.

In *Echium*, because the corollas are zygomorphic and have developed distinguishable upper and lower lips, the manner in which they are displayed on the cyme and the fact that they become resupinate are readily established. This mode of display, however, is not unique. In Southern California, recently, it was observed in *Cryptantha* and *Amsinckia* and, most interestingly, also in *Phacelia*, a member of the Hydrophyllaceae which also develops scorpioid cymes. In *Amsinckia intermedia* F. & M. the habit is well developed, and the resupinate nature of the corolla is also readily determined, since the corolla-limb is oblique (with the abaxial pair of lobes less spreading than the other three), and since the stamens are borne at three superimposed levels in the corolla-tube and the abaxial medial stamen is always identifiable by the high point of attachment and the usually large size. As in *Echium* the corollas of *Amsinckia* face backwards at anthesis and bear their identifiable odd stamen and the two-lobed abaxial lip uppermost. Additional examples of this habit of bearing backwardly directed resupinate flowers at the summit of the scorpioid cyme will doubtless be found in other species and genera of the Boraginaceae. Although it is difficult to believe that the habit has escaped previous attention, I am forced to report that I can find no mention of it in the literature.

Among the continental species of *Echium* the corolla is always prolonged on the abaxial side and usually very distinctly so. It is most commonly obliquely funnelform but in some species can approach a distinctly tubular form. It may attain as much as 30 mm. in length, as in the attractive large funnelform corollas of *E. plantagineum*, or be very small (only 8–12 mm. long), as in the subtubular flowers of *E. arenarium* and *E. parviflorum*. The zygomorphy of these corollas is always evident, not only in their outward form, but also in the arrangement and differentiation among their stamens. In their departure from radial symmetry the corollas of the Mediterranean *Echia* are the most extreme in the Boraginaceae. Except in *E. italicum* and its allies, the stamens are always borne at three evidently different levels on the corolla walls. In all species the medial (abaxial) member is clearly individualized by its form, manner of attachment, and lowest position.

The insular species are not only distinct as to growth-form, but also in the character and degree of specialization of their corollas. A few of the island plants have tubular corollas, e.g., *E. stenosphon* and *E. onosmaefolium*, but in most of the insular species the corolla is relatively short and broad and somewhat obconic in form. The corolla usually has a limb that is nearly regular or only slightly (though still perceptibly) longest on the

abaxial side. Surprisingly, however, in five species related to *E. giganteum* (cf. Sprague & Hutch. Kew Bull. 1914: 116-122, f. 1-5, 1914), and at least also in *E. Decaisnei*, the corolla is most prolonged not on the abaxial but very definitely on the three-lobed axial side. Among the insular species, hence, the corolla may be prolonged abaxially or adaxially or be regular or nearly so. In all these corollas, however, there is some evidence of bilateral symmetry in the arrangement and differentiation among the stamens. In about half of the insular species the axial pair of stamens is affixed obviously higher on the corolla than the remaining three. In addition, the odd medial stamen is usually recognizable because of its distinctive form and manner of attachment. In the other half of the insular species the stamens may be all affixed at or about the same level on the corolla, but in most of these at least the medial abaxial stamen has distinctive characteristics and is so identifiable. Only in a few of the species, such as *E. nervosum* and *E. simplex*, are the stamens all so similar in general appearance and height of attachment that the medial one is distinguishable only with difficulty. In these species, however, the corolla is very slightly but still perceptibly prolonged on the abaxial side. Though zygomorphy is here reduced to a minimum in the androecium, there is at least a modest expression of it in the corolla form.

In general level of evolution and organization, the flowers of the insular species are in many ways more similar to those of *Lobostemon* than to those of the Mediterranean species of *Echium*. As has been indicated, it seems probable that *Lobostemon* is directly derived from *Echium* or its immediate ancestors, and like both the Mediterranean and the Atlantic island *Echia* has achieved distinctive features through a long period of isolation. Since we appear to be dealing with different products from the dissolution of a former widely ranging group, the general similarities in the flowers of *Lobostemon* and the insular *Echia* can have significance. A few species of *Lobostemon* are herbaceous perennials, and some are merely frutescent, but most of them are shrubs, usually a meter or less high. Accordingly, in both *Lobostemon* and the insular species of *Echium* relatively simple features of floral structure are combined with a prevailingly woody habit. In this combination of features we probably have the cause and the effect. Evolution of habit in the Mediterranean has been directed quite differently from that on the islands and in South Africa. The assumption of the herbaceous habit by the species of the Mediterranean area entailed not merely a shortening of the life-span of the individuals; what is more important, it also brought more frequent generations within the various races of these plants. With the generations occurring more frequently in the herbs than in the shrubs, in the same period of time tendencies for evolutionary change would proceed more rapidly and reach more extreme expression in the herbs than in the shrubs. The woody insular *Echia* and *Lobostemon*, having a slower rate of evolution than the Mediterranean herbs, should retain more of the characters of their common ancestors and so present the most over-all similarities.

The annulus in *Echium* is usually represented by ten minute glabrous

or hairy lobes. It encircles the corolla tube usually 0.15–0.2 mm. above the base and is usually less than 0.25 mm. wide. The annulus is accordingly very small and is located unusually low in the corolla-tube. It is always lobed, commonly with the lobes thickish, rounded, nearly as broad as long, and closely juxtaposed, but in some species it is reduced to hardly more than five to ten hairy swellings or to scarcely more than a lineate ring with obscure lobes. It may be glabrous, sparingly strigose, or villulose in various degrees.

The annulus in its various modifications is evidently a useful feature in characterizing species. Its value in defining larger groups within the genus, however, seems doubtful. Coincy, Act. Cong. Intern. Bot. Paris 346–52 (1900) and Bull. Herb. Boiss. ser. 2, 3: 261 (1903), proposed three sections of the genus which he distinguished solely by differences in the annulus. Between the extreme types which he emphasized, however, there are all intermediate stages. Furthermore, the groups defined by stressing the nature of the annulus are not at all convincingly natural. Indeed, they are much less so than groups which can be defined by use of growth-habit or corolla-form or stamen-arrangement.

The members of the androecium in *Echium* vary considerably from species to species in size and form and in position and manner of attachment. The abaxial medial filament is always individualized. It may differ in length from the other four filaments or be borne lower on the corolla, or the character of its base and the manner of its attachment to the corolla may be distinctive. In most continental species it differs in all these respects. Among the insular species, however, the odd filament tends to be very slightly if at all lower than those immediately adjacent and differs very little if at all in length. It is usually most easily recognized by the distinctive form and attachment of its base.

The filaments of the Mediterranean species are arranged in three groups. The adaxial pair is affixed highest on the corolla, the abaxial two laterals at an intermediate level, and the odd medial (abaxial) one lowest. In *E. italicum* and its allies these differences may be slight, but in the other continental species they are very marked. Besides differing in height of attachment, the three groups may also differ in length and degree of exertion from the corolla. The adaxial pair tends to be most protrudent and in a few species may be alone exerted. In *E. parviflorum* and *E. arenarium* no stamens are exerted. Although prevailing the stamens of *Echium* are glabrous, occasional forms of *E. plantagineum* and related species may have the upper pair of filaments glabrous and the other three sparingly hairy. Among the insular species the androecium is more simply organized than in the species of the Mediterranean. At most, the stamens are affixed at only two evidently differing levels on the corolla and among some species may be affixed all at practically the same level. The filaments tend to be of about the same length and are practically always equally well exerted.

In most species of this genus the filaments (and the style) have become so elongate before the corolla opens that in order to accommodate their

length to their cramped quarters they necessarily become excessively decurved, frequently to such an extent that their tip comes to lie close to their base. After the corolla opens some of this curving tends to persist even after the stamens are fully exerted and so produces the declinate filaments, a characteristic feature of the flowers of *Echium*.

It is to be noted that *Echium*, like most other genera of the Lithospermeae, has anthers that dehisce while the flower is in bud and always before the corolla opens. In the present genus, because of the decurved filaments, the anthers, when they dehisce, may have a position deep in the throat of the still unopened corolla and adjacent to the tip of the decurved style. This frequently occurs in flower buds in which the immature corolla has not yet surpassed the calyx or as yet attained half of its eventual length. If self-pollinization is possible, there is an excellent opportunity for it before the flower opens.

Neither heterostylous nor specialized cleistogamic flowers are known in *Echium*. Within the genus, however, there are species which have forms that differ in size, organization, and function of their flowers. The condition is best known in *E. vulgare*. In addition to the usual form of that species, which produces functionally bisexual flowers, there is another less common form that has distinctly smaller, functionally female flowers. In the latter the style is exerted but the short stamens are included and never mature pollen. Similar functionally female forms have been encountered among the Mediterranean species which I have dissected. The indications are that gynodioecism, of the sort long recognized in *E. vulgare*, occurs in many of the herbaceous species.

A more complicated floral heteromorphism has been recently reported by Camus, Bull. Soc. Bot. Fr. 84: 451-57, figs. (1937), among plants of *E. candicans* L. cultivated in gardens of southern France. Some of these plants had relatively large corollas with salient stamens and style, others had smaller corollas with the stamens included but the elongate style exerted, while still others with equally small corollas had the stamens and the excessively short style both included. Each of the three types of flowers was associated with an inflorescence distinctive in form. Viable pollen was produced abundantly in the first type of flower, not at all in the second, and only scantily in the third. It would appear that we are concerned here with gynodioecism in which not one but two types of female flowers are involved. Among the herbarium material of the insular species which has been dissected I have found evidences of gynodioecism only in *E. strictum*. One of my specimens (Laguna, Teneriffe, March 1855, *Perraudière*, s.n.) has short included stamens producing no pollen and appears to be the small-flowered functionally female form of that species.

The anthers of *Echium* are usually small, relatively broad, and commonly ca. 0.6 mm. long. Only in a few of the continental species are they oblong and as much as 1.2 mm. in length. The connective is very distinctive. It is somewhat cartilaginous in texture and relatively broad and at the middle bears a well-developed pit in the depths of which the filament is attached. This pit in which the filament is joined to the anther is a

unique feature shared with *Echium* only by *Lobostemon*. The apex of the anthers is rounded or obtuse, but their base is distinctly emarginate. In the female flowers of gynodioecious species, in which the stamens are only imperfectly developed, the sterile anthers are always erect. In the perfect flowers, however, the anthers are displayed in an inverted position, with their basal end (that with the sinus) held uppermost. The line of dehiscence on the anther-theca is usually lateral to its medial line, and the expanded thecae are accordingly usually asymmetric. On certain herbarium specimens representing various different species of *Echium* (and also *Lobostemon*), the opened anthers may have the margin of the theca more or less ciliate with very slender elongate incurving hairs. Similar slender hairs may also arise from along the midline of the open empty theca. The condition is not uncommon, though it is usually best developed in specimens of *E. plantagineum* and its allies. The precise nature of these hair-like structures is uncertain. Under high magnification they are revealed to be unicellular, unbranched, and frequently collapsed. Interestingly, at irregular intervals along their length they become locally swollen. If these "hairs" be pollen-tubes they are unusually rigid for that organ, and if projecting ends of mycelium their rigid character is likewise unusual. In either case their restriction to the margin and middle of the theca is difficult to understand.

Pollen of *Echium* shows little variation from species to species, differing only slightly in size and only moderately in the relation of length to breadth. The grains are ovoid or conic-ovoid and bear their three pores equidistant about their broadest part just above the broadly rounded base. In general they much resemble the grains of *Alkanna*, but above the pores are more gradually constricted and their apex accordingly broader and less pointed. The extremes, in the more than forty samples examined, are $16-26 \times 13-25 \mu$. The grains of the Mediterranean herbs (commonly $22-25 \times 13-25 \mu$) are larger than those of the island species, commonly $18-22 \times 20 \mu$.

The nutlets of *Echium* are basifixed and have a prominent, very elongate ventral keel formed of a fused suture. In *E. orientale* and in *E. Rauwolfii* they are nearly smooth and in the latter even lustrous, but in almost all other species they are dull and more or less tuberculate. In some of the Canary Islands species, such as *E. simplex*, the pericarpial protuberances become so large and so very coarse that the nutlet has the appearance of being lobed. The nutlet body, though straight or at most only obscurely incurved in most species, becomes very distinctly bent in some of the island species, e.g., *E. exasperatum*, *E. Webbii*, *E. giganteum* and allies. In these latter the nutlet is sharply bent at the middle at an angle of ninety degrees in a manner suggestive of the nutlet of *Moltkia* and *Hulacsya*, which it tends to resemble. The attachment scar on the nutlets of *Echium* is basal, usually horizontal or nearly so, and commonly flabelliform. Among the insular species it is frequently green in color, as is frequently the case in *Moltkia*. The nutlet body tends to be narrowed at the base and is frequently somewhat constricted just above the attachment. The scar,

accordingly, is usually much smaller than the maximum diameter of the body. The disrupted funicular canal usually forms a conspicuous pit in the ventral angle of the scar. The ends of several vascular strands form an arc towards its dorsal edge.

The gynobase is usually flat. Occasionally, however, it may become distinctly pyramidal, and the nutlets borne upon it are parallel only when incurved. Straight nutlets on such an elevated gynobase are somewhat diverging. The style is always sparingly but distinctly hairy and usually contains two distinct vascular traces, at least above the middle. It is simple and terminated by two small, distinct, closely juxtaposed stigmas in *E. rubrum*, but in all other species is distinctly forked below the tip. The two lobes tend to be subulate and commonly are unequal in length. They are each terminated by a very small stigma.

As here defined, *Echium* includes *E. orientale* L., a species which recent botanists have separated from *Echium* and treated as forming the monotypic genus *Megacaryon* Boiss. The distinctive characters of the plant are supposed to be its rank habit of growth and its very large, nearly smooth nutlets. In biennial habit and the organization of its corolla and androeceum, the species agrees with other continental species. In coarseness of habit it is no more remarkable than *E. pomponium*, another continental species. In any case, in a genus such as *Echium*, which contains such great diversity in types of habit — from lowly annuals to woody plants up to five meters tall — it is utterly inconsistent to emphasize habit in any attempt to justify the generic segregation of *E. orientale*. Smooth nutlets, though uncommon in *Echium*, do occur in *E. Rauwolfii*. With this fact recognized it becomes evident that *E. orientale* is particularly notable only from the relatively large size of its nutlets, certainly no basis for the recognition of a segregate genus.

6. *Lobostemon* Lehm. *Linnaea* 5: 378, t. 5 (1830); Levyns, *Jour. Linn. Soc. Bot.* 49: 393–445 (1930). Type species *L. echiioides* Lehm.

Lobostema Spreng. *Gen.* 1: 126 (1830), a variant spelling of *Lobostemon* Lehm.

Echiopsis Reichenb. *Handb.* 192 (1837). Type species *Echium fruticosum* Pers.

Isorium Raf. *Fl. Tellur.* 2: 61 (1836). Type species *Echium formosum* Pers. (= *L. grandiflorus* Levyns).

Traxara Raf. *Fl. Tellur.* 4: 85 (1836–38). Type species *Echium capitatum* L.

Oplexion Raf. *Fl. Tellur.* 4: 86 (1836–38). Type species *Echium ferox* Pers. (= *L. argenteus* Buek).

Penthysa Raf. *Fl. Tellur.* 4: 86 (1836–38). Based upon *Echium fruticosum* L., *E. glaucophyllum* Jacq., and *E. laevigatum* L.

Echiostachys Levyns, *Jour. Linn. Soc. Bot.* 49: 445 (1934). Based on *Echium incanum* Thunb., *E. spicatum* Burm. f., and *L. Ecklonianus* Buek.

Echium § *Trichobasis* DC. *Prodr.* 10: 13 (1846). Type species *Echium caudatum* Thunb. (= *E. spicatum* Burm. f., *Prodr. Cap.* 4, 1768 = *Lobostemon spicatus* comb. nov.).

Lobostemon § *Trichobasis* (DC.) Gürke in E. & P. Pflanzenfam. IV, Abt. 3A: 128 (1893).

Echium § *Synlobus* DC. Prodr. 10: 15 (1846). Type species *Echium formosum* Pers.

Lobostemon § *Synlobus* (DC.) Gürke in E. & P. Pflanzenfam. IV, Abt. 3A: 128 (1893).

Plant perennial, sometimes suffrutescent or herbaceous but usually distinctly fruticose, mostly small shrubs; hispid or strigose or nearly glabrous; leaves thickish, numerous, veinless or nearly so, all cauline. Cymes densely to loosely scorpioid, forked or simple, conspicuously bracted, frequently becoming very loose at maturity, few- to many-flowered, usually borne terminally or subterminally on leafy branches but sometimes reduced to few-flowered axillary glomerules and aggregated to form a loosely spicate or a very dense cylindric thyrse. Calyx usually 5-parted, only rarely tubular below the middle, sessile or distinctly pedicellate, small or nearly half as long as the corolla; lobes equal or very unequal (or sometimes all dissimilar), frequently with the anterior lateral ones best developed, sometimes with the anterior three more or less united, moderately or very weakly accrescent at maturity. Flowers monomorphic. Corolla blue, pink, white or red, small to large, nearly regular or more commonly somewhat zygomorphic, tending to be prolonged on the abaxial side, outside somewhat strigose or glabrous, inside without stipitate glands or true faucal appendages, glabrous except for hairs on and about the infra-staminal appendages or on the tube below them; corolla-lobes ascending or spreading, rounded, subequal or with the abaxial two perceptibly the largest; limb frequently oblique; tube cylindric or slightly bent and swollen abaxially; throat usually gradually expanding, commonly funnelform and as long or longer than the tube but in some species becoming very abruptly ampliate and shallow and not much if at all longer than the tube; annulus highly specialized and represented by the infra-staminal appendages. Stamens 5, all arising at or near the same altitude on the corolla, or the axial pair highest on the corolla, the medial abaxial one lowest and the two abaxial lateral ones at an intermediate level; filaments slender, usually with a prolonged decurrent base, arising at or below the middle of the corolla, equal or unequal, the abaxial one usually shorter than the two adaxial, all exserted or some or all included, weakly or not at all declinate; the abaxial medial stamen frequently distinguishable by its low attachment or its short length. Infra-staminal appendages (apparently modifications of the annulus) borne at or below the attachment of the stamens and at equal altitudes on the corolla walls and usually conspicuously above the corolla-base, usually tumid and frequently with squamose margins, conspicuously villose at least on the edge, sometimes spreading and shelf-like but usually with the rim ascending and forming a villose cup or a pocket-like recess, sometimes merely a tumid area bearing a cluster of hairs or a transverse densely villose arcuate ridge, at other times represented merely by a short thickened section of the decurrent base of the filament which is densely villose about its thicker upper end. Anthers small, short-oblong, attached to the filament in a pit

near the middle of the thickened connective, usually displayed inverted with the base uppermost. Pollen ovoid or conic-ovoid ($16-28 \times 13-22 \mu$), broadest above the broadly rounded base and then gradually narrowed to the narrow rounded apex, polar profile circular, usually with the pores slightly protrudent or their position marked by three nicks in the circumference; pores 3, arranged equidistant about the broadest part of the grain. Style slender, with or without appressed slender hairs, not lobed, terminated by 2 very small juxtaposed stigmas, included or exerted, straight or somewhat declinate. Nutlets erect, one to four maturing, sparingly to abundantly tuberculate or even muricate or nearly smooth, venter angulate, prominently keeled, the suture obliterated; dorsum usually with a medial keel at least above the middle but sometimes keeled to the base and with lateral keels also; attachment scar usually large, basal, horizontal or somewhat oblique. Gynobase depressed pyramidal, the attachment faces usually large and well defined.

A group of South African plants containing 25-30 species. It has obvious affinities with *Echium* and was probably derived from the same immediate ancestors. The nature of its relations with *Echium* has been discussed under that genus. *Lobostemon* is distinguished from *Echium* only by having the annulus in the corolla modified into conspicuous, specialized infra-staminal appendages which, unlike the lobes of the annulus in *Echium* and other Boraginoideae, are borne not merely near the base of the corolla but also conspicuously above it. In *L. echioides* the extreme modification and elevation of the annulus has produced flowers with features conspicuously different from those in *Echium*, but in *L. montanus* the flowers are very similar in appearance and general organization to those found in *Echium*, and indeed differ from them only in the large rather than small size of the annulus-lobes. The differences between *Lobostemon* and *Echium* are those between a very small, inconspicuously hairy, simple annulus always borne very close to the base of the corolla and a large villose annulus, frequently with conspicuous squamate outgrowths, which may be near the corolla-base but is usually evidently above it. The only absolute difference, it is to be noted, is that of size. According to D. M. Britton, *Brittonia* 7: 248 (1951), ". . . all the *Lobostemons* examined have a basic chromosome number of seven. All the *Echiums* except *Echium hispidissimum* R. Lit. ($2n = 14$ and 28), have a basic chromosome number of eight." Although it has become traditional to give generic recognition to the South African plants, it is to be recognized that with much justification they could be treated as constituting merely one of the well-marked sections of *Echium*.

The most recent study of *Lobostemon* is by Levyns, *Jour. Linn. Soc. Bot.* 49: 393-452, f. 1-16, t. 29 (1934). Unhappily the author compartmentized her study, and despite the obvious relations of the genus with *Echium*, appears to have made no attempt to familiarize herself with the variety of structures in that genus. Her discussion of the infra-staminal appendages as organs *sui generis* and her selection of *L. echioides* as the most primitive species in her discussion of phylogeny are equally un-

acceptable for anyone having familiarity with the range and types of floral structure in *Echium*. Also unacceptable is her segregation of the allies of *L. spicatus* and her erection of the genus *Echiostachys* for them. This proposed segregate genus differs from the species remaining in *Lobostemon* only in the herbaceous habit and very dense cylindrical thyrses. The differences in habit and inflorescence dignified are no more striking nor important than those existing between groups of species in *Echium*, and are no more worthy of generic recognition.

In general organization the corollas of *Lobostemon* are very similar to those of *Echium* and in some species are almost identical. The only important differences are those concerned with the elaboration of the annulus and the accompanying elongation of the basal section of the corolla-tube. As in *Echium* the corollas of *Lobostemon* are more or less evidently zygomorphic and tend to be most elongate on the two-lobed abaxial side. Accompanying this is another strong tendency, that for the abaxial medial stamen to be differentiated, commonly by being shortest, and frequently also by being affixed lowest on the corolla walls. In *L. echioides* and its relatives, though the corolla may be practically regular, a close examination usually reveals the abaxial pair of lobes slightly but still perceptibly larger than the other three, and furthermore, the abaxial medial stamen appreciably shorter than its companions. Although in the *L. echioides*-group the filaments usually arise directly above the appendages and accordingly from the same height above the corolla-base, sometimes (especially the axial pair) they tend to become decurrent for a short distance above the appendages before becoming free. However, when this tendency is present, it is always most weakly expressed in the medial stamen. In other groups of the genus the filaments are usually all evidently decurrent for some distance above the appendages. The differentiation among the stamens is similar to that in the Mediterranean species of *Echium*. In *L. montanus* the filaments are all decurrent 5–6 mm. and become free at nearly the same level above the corolla-base, and all are about the same length. Although the corolla is most prolonged on the abaxial side, the abaxial filament is only very obscurely shorter and lower than its companions. In other relatives, e.g., *L. fruticosus*, *L. argenteus*, and *L. glaucophyllus*, the adaxial pair of filaments are evidently longest and the abaxial stamen is shortest. The other stamens may be intermediate in size and position. It is a general rule in *Lobostemon* for the abaxial stamen to be shortest and for the remaining four stamens to be either nearly equal in length or the higher pair to be longest. In *L. montanus* all stamens may be exserted, but in its relatives frequently only the highest (the adaxial) pair of filaments equal or surpass the tips of the corolla-lobes. The short stamens are practically always included. This unequal exsertion of the stamens has numerous parallels among the Mediterranean *Echia*. Interestingly, the flowers of *Lobostemon*, unlike those of *Echium*, frequently have the paired stamens with members although practically equal, still not precisely equal in length. Indeed, in some flowers, although there are three well-marked groups of stamens, because of the slight but still evident differences in length within the pairs

there are no two stamens within the corolla which are precisely the same length.

The infra-staminal appendages of *Lobostemon* are the most distinctive feature of the genus. These structures, as apparently first suggested by Bunge, *Heliocarya* pg. 11 (1871), appear to be specialized elaborations of the annulus, a structure which in *Echium* consists of an annular arrangement of five to ten very small lobes borne scarcely above the base of the corolla. The appendages in *Lobostemon* are usually borne on the ridges representing the downwardly decurrent base of the filaments. In *L. montanus* they are located 0.5–1 mm. above the base of the corolla and are in the position at which the annulus is developed in most Boraginoideae. They consist merely of a short specialized section of the ridge below the filament-attachment which is swollen, darkened, and apparently secretory in nature, and conspicuously villous about the thicker and usually somewhat excavated upper end. These infra-staminal appendages of *L. montanus* give every evidence of being no more than a specialized development of a five-lobed annulus. In other species of *Lobostemon*, however, the relation of the infra-staminal appendage to the annulus in other genera is much less obvious. Their position is no longer near the base of the corolla, the conventional position of the annulus, but rather well above it and at times even as much as half-way up the corolla. That section of the corolla which is below the annulus, which in other genera is weakly developed (usually less than 1 mm. long) is in *Lobostemon* elongated and in some species of the genus actually forms the tube of the corolla. It is as a result of intercalary growth in this basal section of the corolla that the annulus has achieved its relatively high position on the corolla. Besides being borne well above the corolla-base, the annulus of *Lobostemon* has become relatively large and has also developed distinctive forms. In some species it consists merely of five villous areas (*L. spicatus*) or five swellings, each decorated by an arcuate lineate ridge bearing abundant hairs (*L. argenteus*). Usually it develops squamate marginal outgrowths and is evidently villous at least on the edge. The squamate margins may be entire or (in *L. hispidus*) more or less distinctly three-lobed. The appendage may be spreading to form a bracket-like shelf (*L. fruticosus*) or be upturned to form a cup or a pocket-like cavity (*L. glaucophyllus*). The most remarkable development of these appendages is in *L. echioides* and allies. In these the appendages are borne at the summit of a well-developed cylindric tube which may be nearly half the total length of the corolla. Since above the tube the corolla expands abruptly and widely into a broad open shallow throat, the appendages filling the opening to the tube are fully exposed to view. They have the general appearance and function of faucal appendages. Unlike true faucal appendages, however, they do not alternate with the stamens. They subtend the protruding stamens which arise directly above them. This condition is unique, for in all other Boraginaceae in which it is developed, the annulus is at most only an obscure structure hidden deep in the corolla, where it functions

either as a nectary or as a collar about the nectary at the base of the ovary.

The anthers and the pollen have all the distinctive features of those of *Echium* and are indistinguishable from them. As in *Echium*, the anthers dehisce before the flower bud reaches full size or the corolla is ready to open. At this early stage the filaments are decurved within the bud and the dehiscing anthers clustered at the middle of the bud cavity. The style may be erect and the stigma pressed against the folded corolla-lobes or be recurved with its stigmas among the dehiscent anthers. In most species of *Lobostemon* it would appear that the plants can escape self-pollinization only if they are self-sterile. Although the longer filaments of *Lobostemon*, as in *Echium*, are strongly decurved within the flower bud, they show less inclination to remain declinate after they become exerted from the open corolla. In most species the filaments at maturity are straight or only slightly curving. As in *Echium*, however, they are bent abruptly subapically and thereby effect the inversion of the anther.

The cymes of *Lobostemon* tend to be less dense or less abundantly flowered than in *Echium*. Most of these South African plants have a cyme which is looser than the densely flowered, distinctly biseriate, very elongating scorpioid cymes characteristic of *Echium*. The closest approach to the latter type is in *L. montanus* and its relatives, the group most like *Echium* in its floral structures. In the species-group of which *L. glaucophyllus* is typical, the flower buds are not very crowded on the younger parts of the cyme and furthermore are almost uniseriate. At maturity these cymes become very loosely flowered and racemose. In *L. echiioides* and allies the inflorescence is more suggestive of *Anchusa* than of *Echium*. Two groups of species have the cymes reduced to very numerous few-flowered glomerules and the latter aggregated into an elongate thyrses. The dense cylindrical thyrses of *L. spicatus* and its allies is very similar in organization to that of *Echium rubrum*. The most distinctive thyrses is that of *L. argenteus*, in which usually two-flowered glomerules, subtended by large bracts, are scattered along the upper parts of the branch to form an elongate, interrupted pseudo-spike.

In *Lobostemon* the pedicels, as in *Echium*, are strict, but unlike in *Echium* the open flowers are usually borne not on the curved summit of the scorpioid cyme but below the summit near the point where the axis of the cyme first becomes straight or nearly so. The open flowers, borne on strict pedicels at the tip of the straightened portion of the cyme axis, are accordingly nearly vertical. This behavior of the flower is especially clear in those species such as *L. glaucophyllus* and allies, in which the cymes are especially loose. It is a transitional state between the customary manner of floral display in the Boraginaceae, in which the flowers, borne on spreading pedicels on the straightened part of the cyme, have the corollas facing directly away from the axis, and the manner in *Echium*, in which the flowers, borne on strict pedicels on the curved summit of the cyme, have the corollas facing in the opposite direction and accordingly inverted. *Echium* has backwardly directed resupinate corollas. *Lobostemon* has the

corolla usually erect and facing upwards. Only in one *Lobostemon*, *L. argenteus*, a species with an interrupted pseudo-spike of one- to three-flowered axillary glomerules, are the flowers distinctly resupinate.

The style in the allies of *L. echioides* may be completely glabrous, but in most species of *Lobostemon*, as in *Echium*, it bears some appressed slender hairs, at least below the middle. As in *Echium rubrum* and allies, but unlike most species of *Echium*, the style of *Lobostemon* is unlobed and terminated by a pair of very minute stigmas. It may be included or only slightly longer than the corolla.

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